Rapid prototyping and mathematical art

Craig S. Kaplan

Computer Science Club talk • 2 April 2009

A quick tour of technologies, techniques, and applications for computer-aided manufacturing in 2D and 3D.

2D

2D Technology

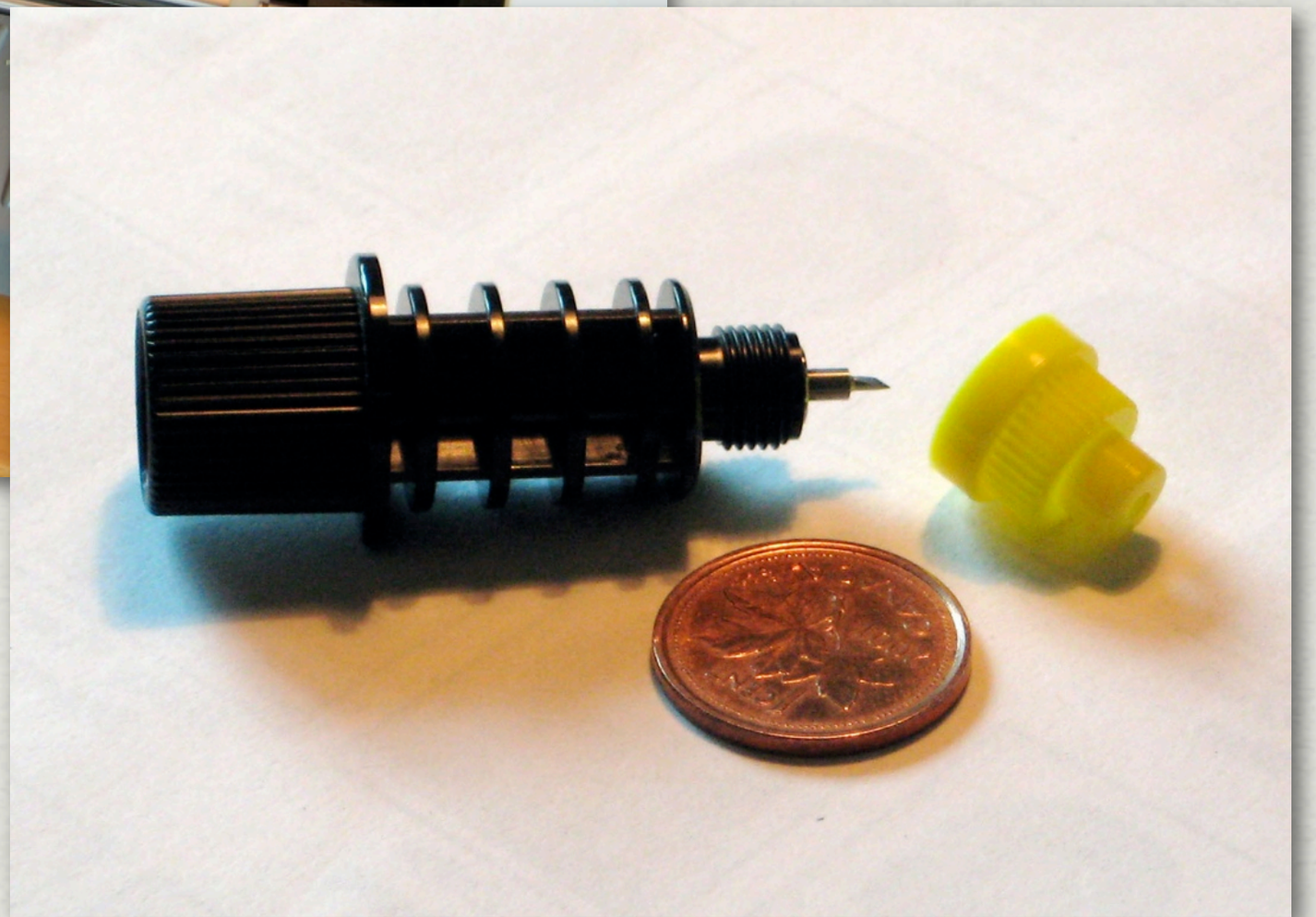
- Tool moves in 2D relative to material
- Can apply varying pressure or intensity

Knife cutter

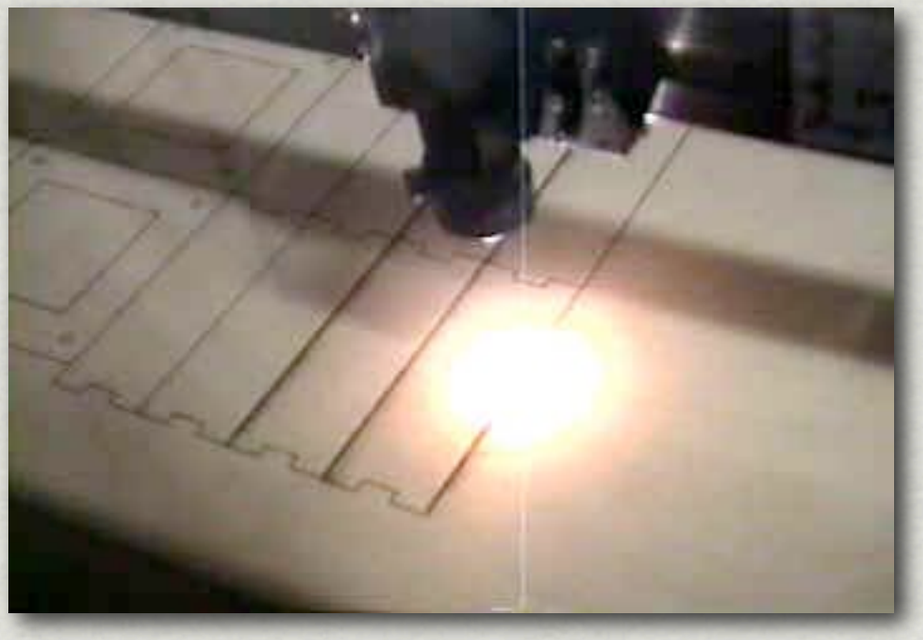
aka Digital Craft Cutter

- Material feeds in and out of device
- Cutting head moves left and right
- Knife moves up and down with varying pressure


刃先調整キャップ
Plunger tips
0.1
0.2
0.3
カッティング用台紙を使用しない場合
Not using the carrier sheet.
カッティング用台紙を使用する場合
When using the carrier sheet.
注　意　手を巻き込まれる可能性がありますのでご注意ください。
刃物を使用しますので手などを切らないように十分ご注意ください。
CAUTION Take care not to get your hands caught.
Take care not to cut yourself on the blade.

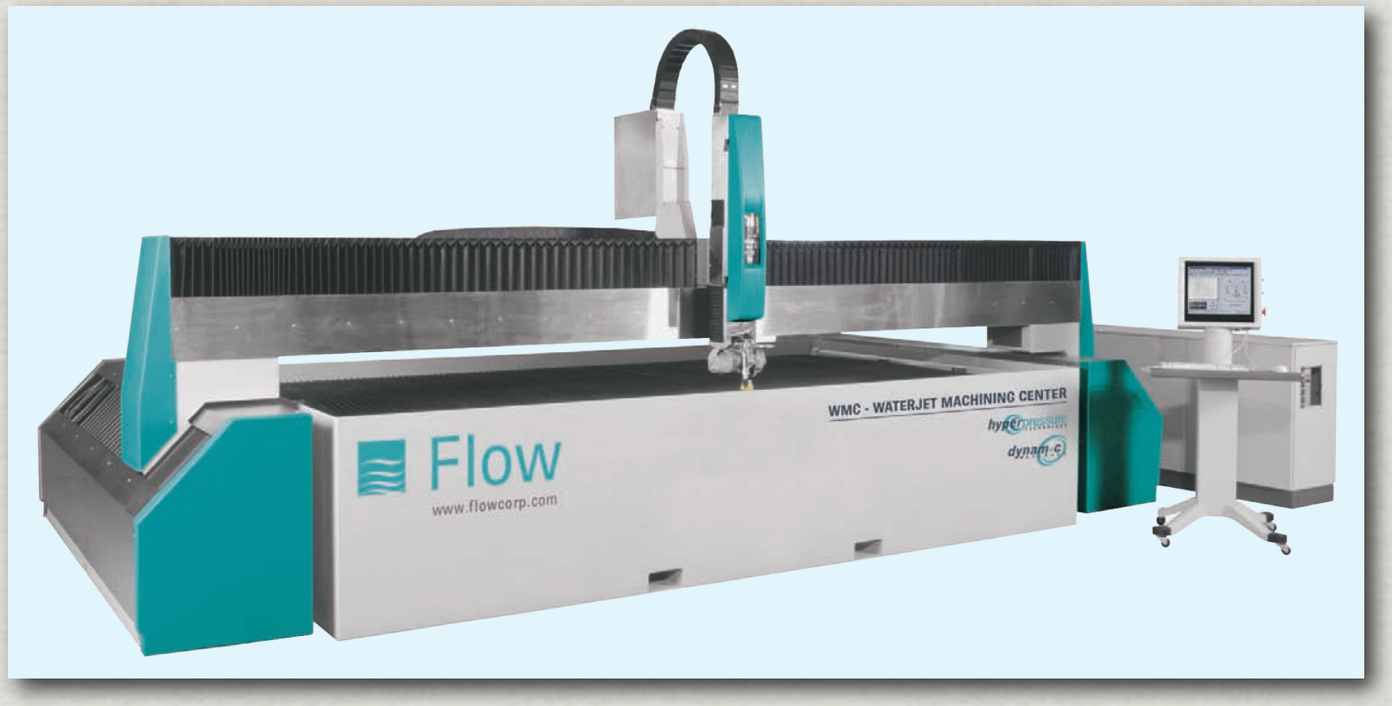


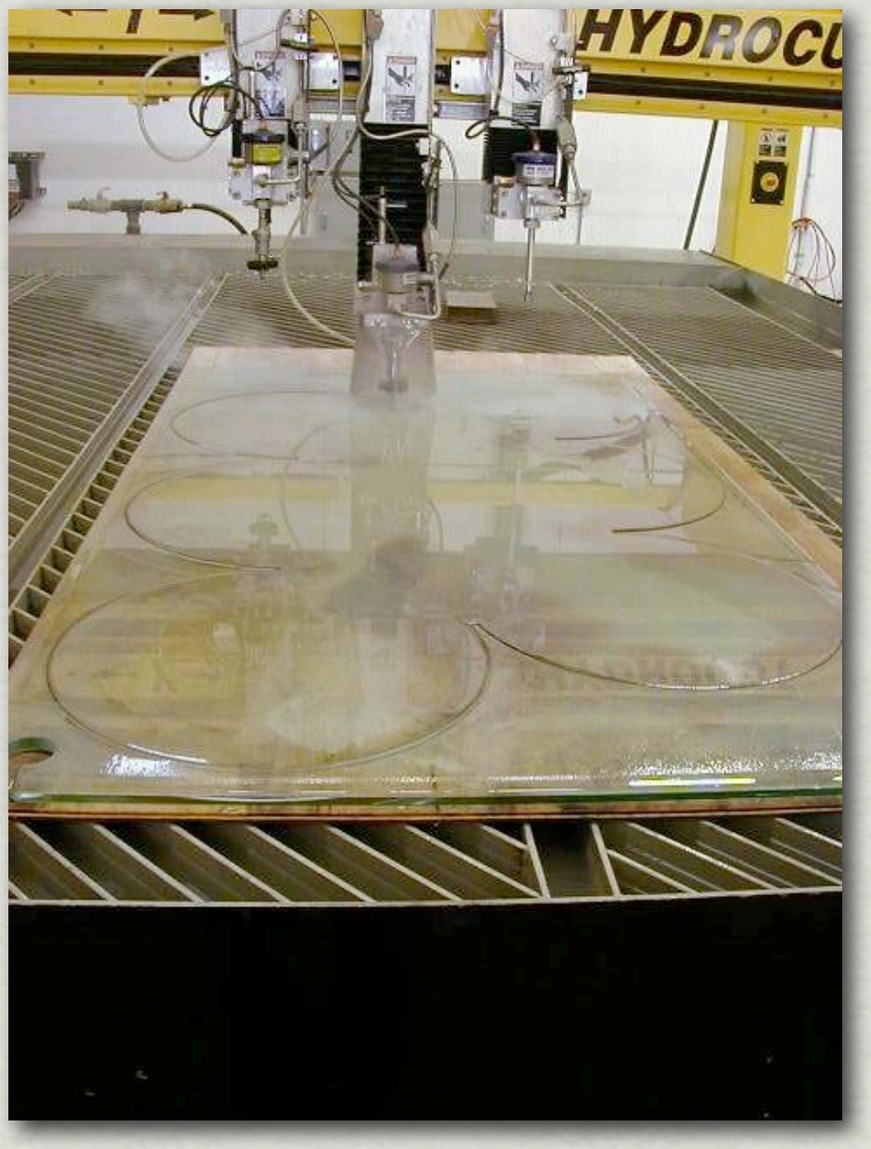
Laser cutter



- Laser lens moves freely in two axes
- Can vary speed and laser intensity

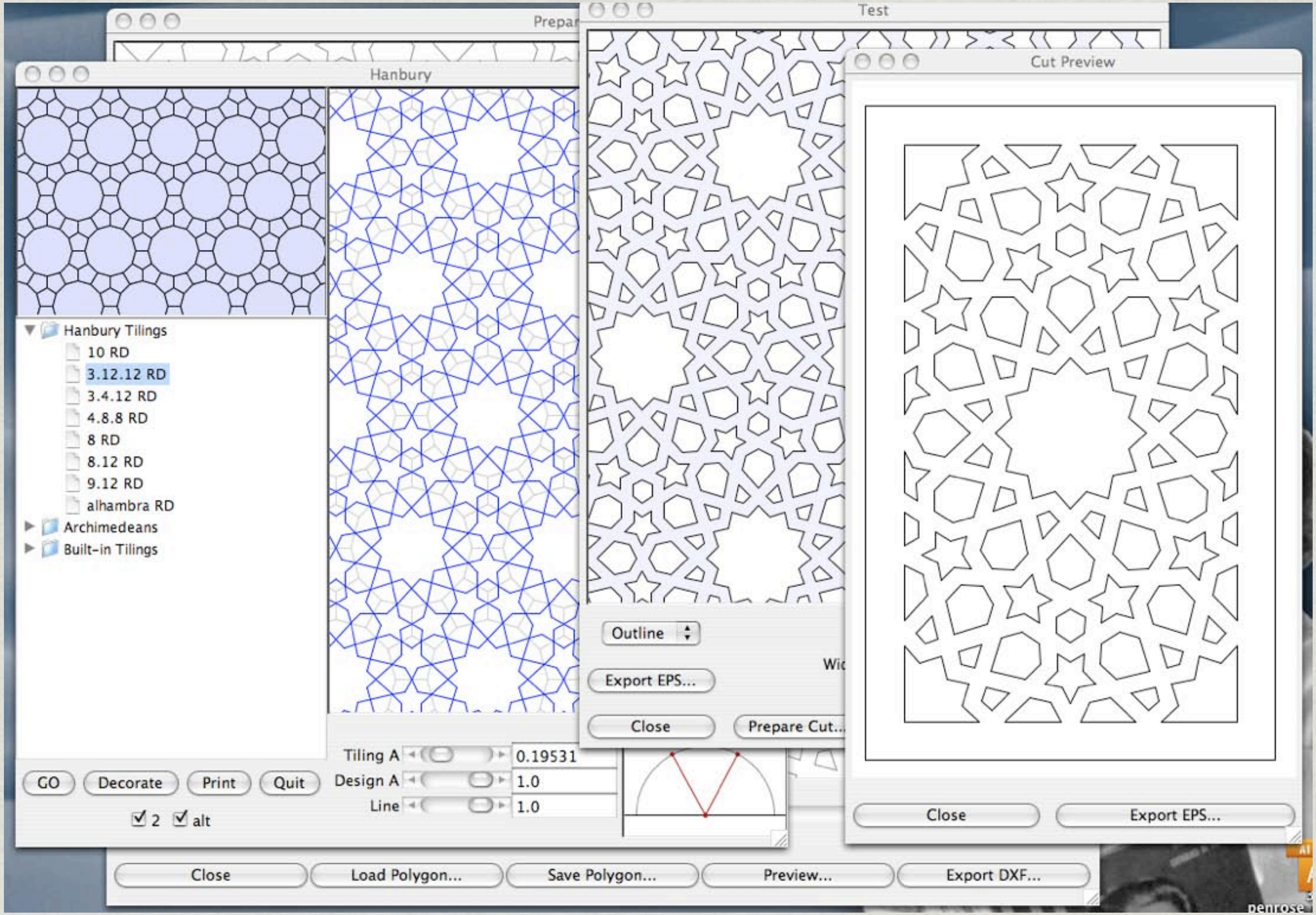
Waterjet cutter

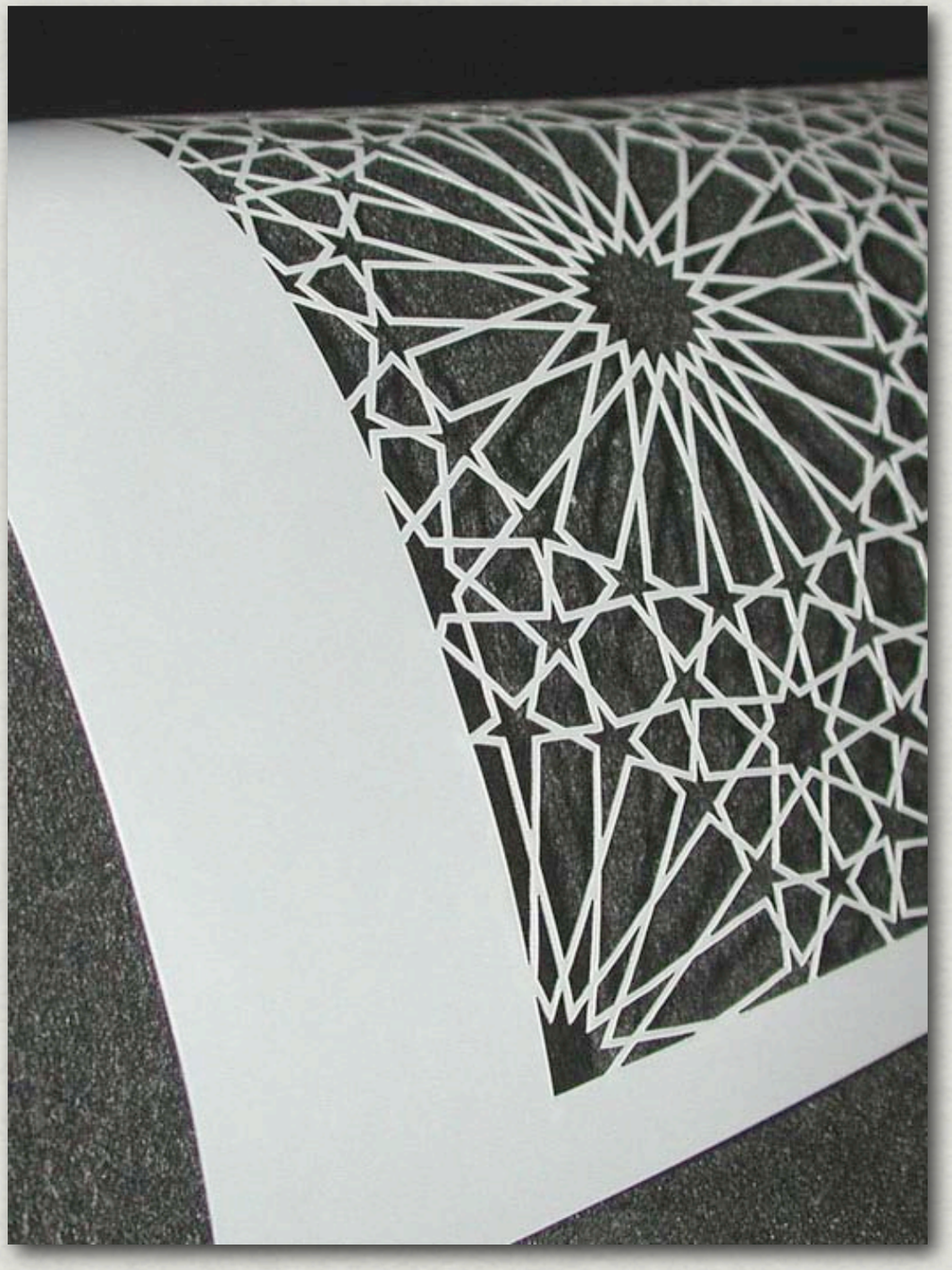




- The top of the line for 2D cutting

Islamic star patterns



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2

3

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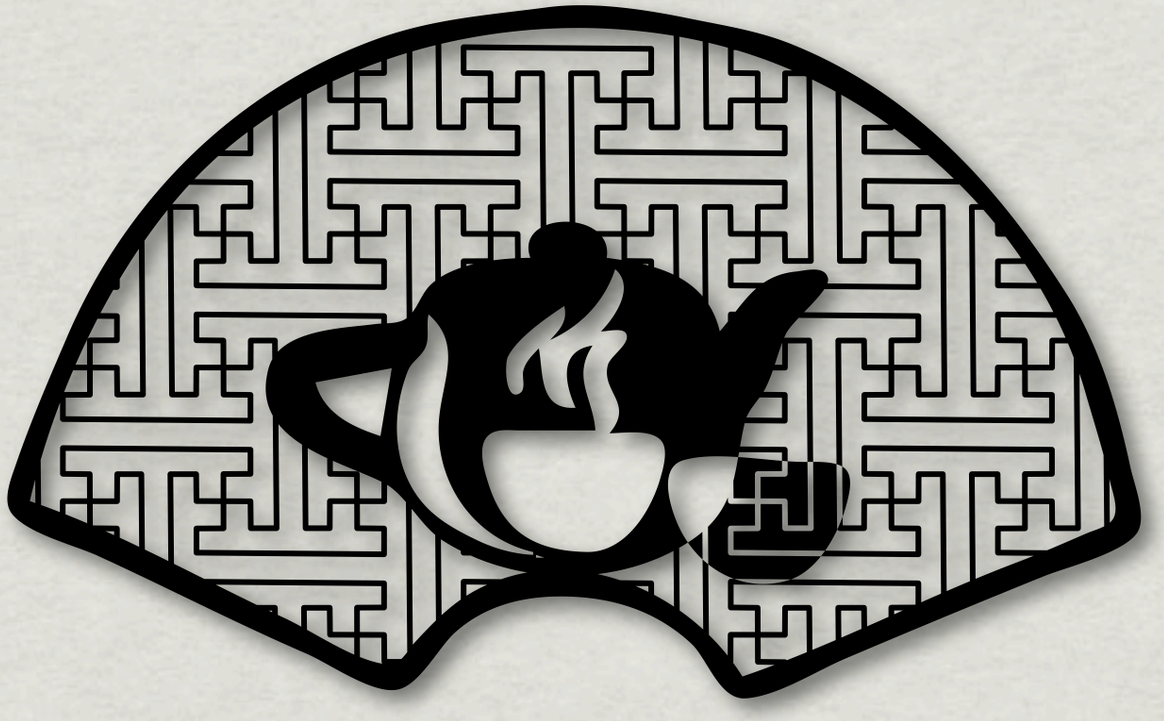
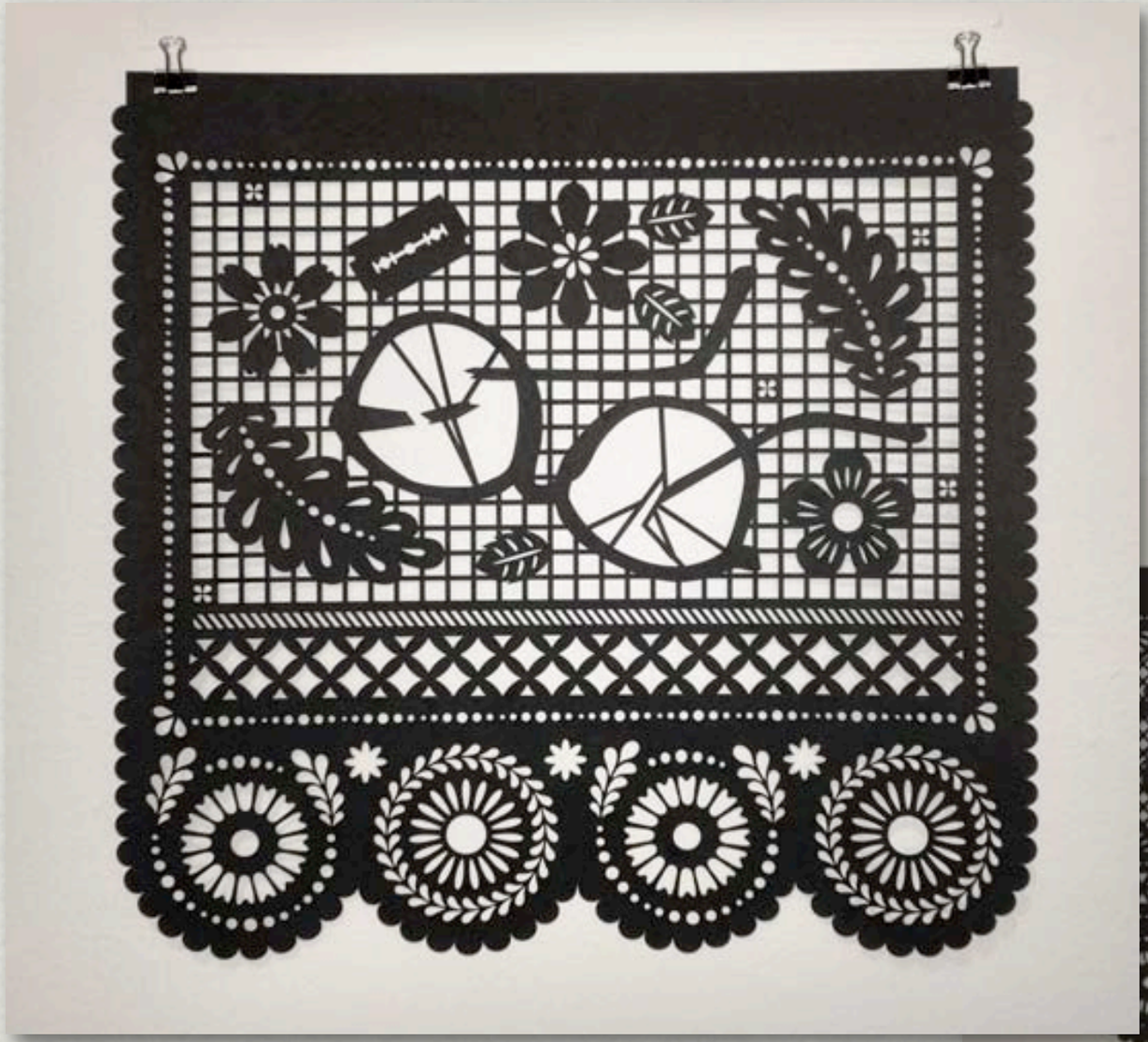
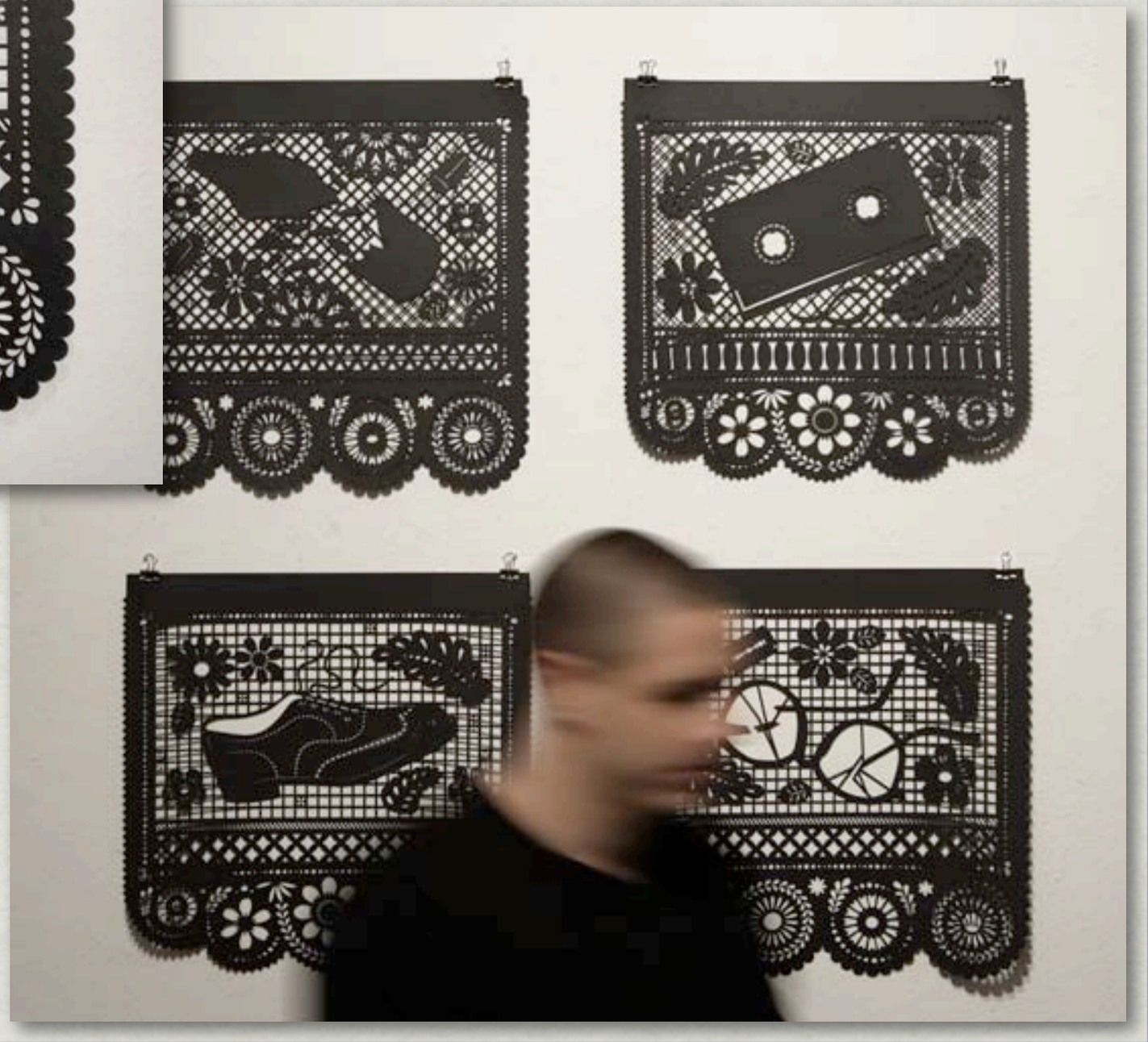
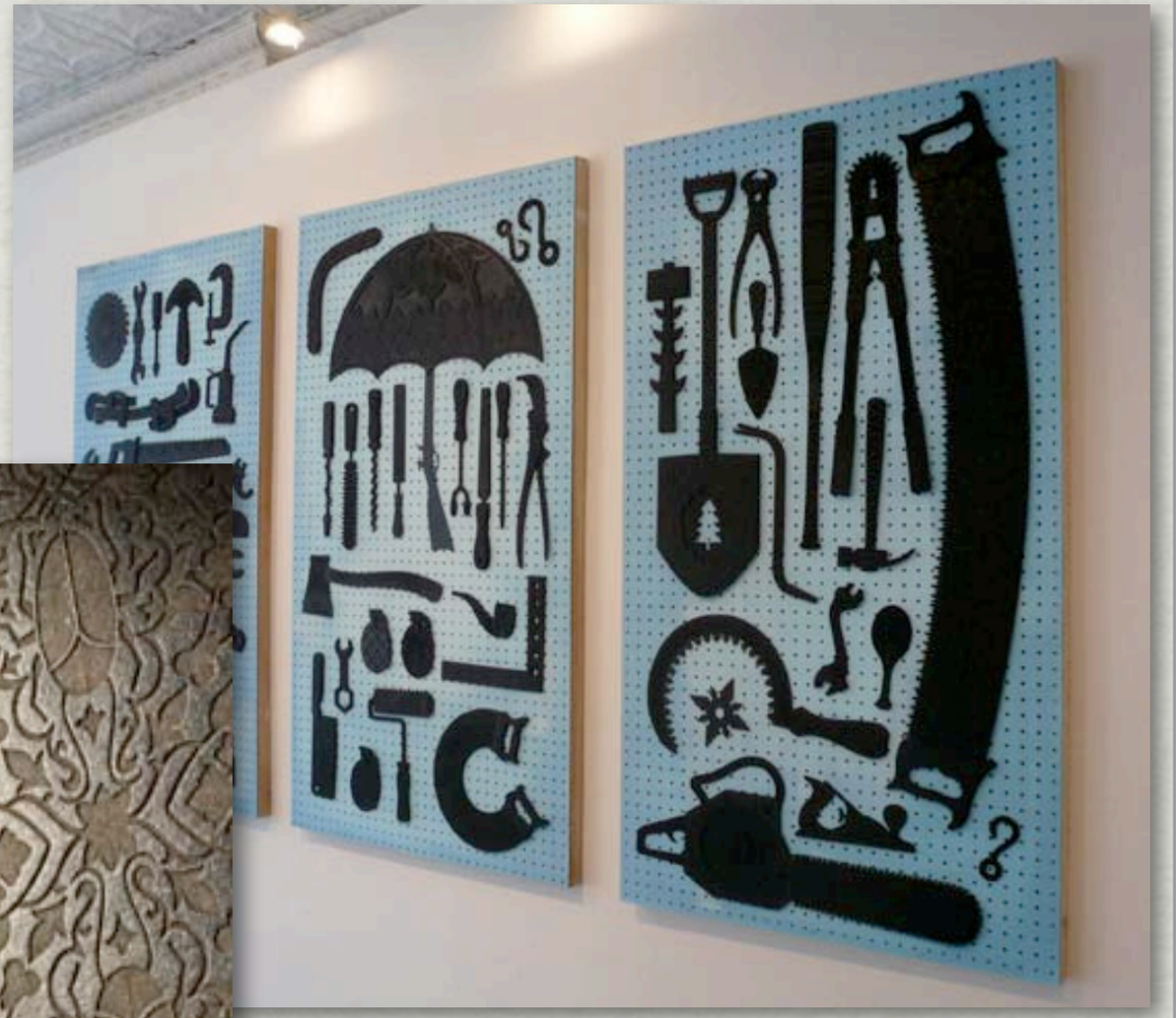




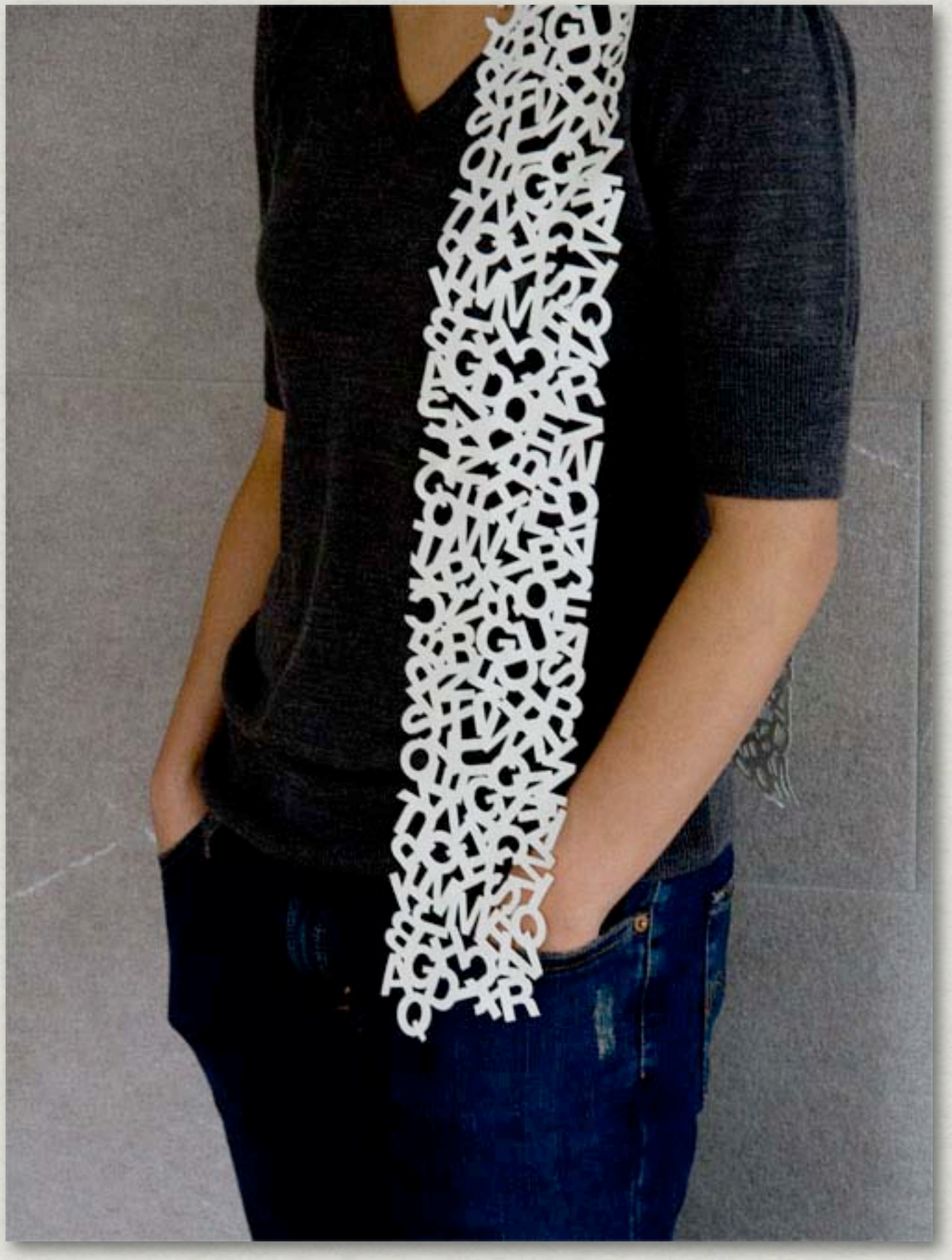


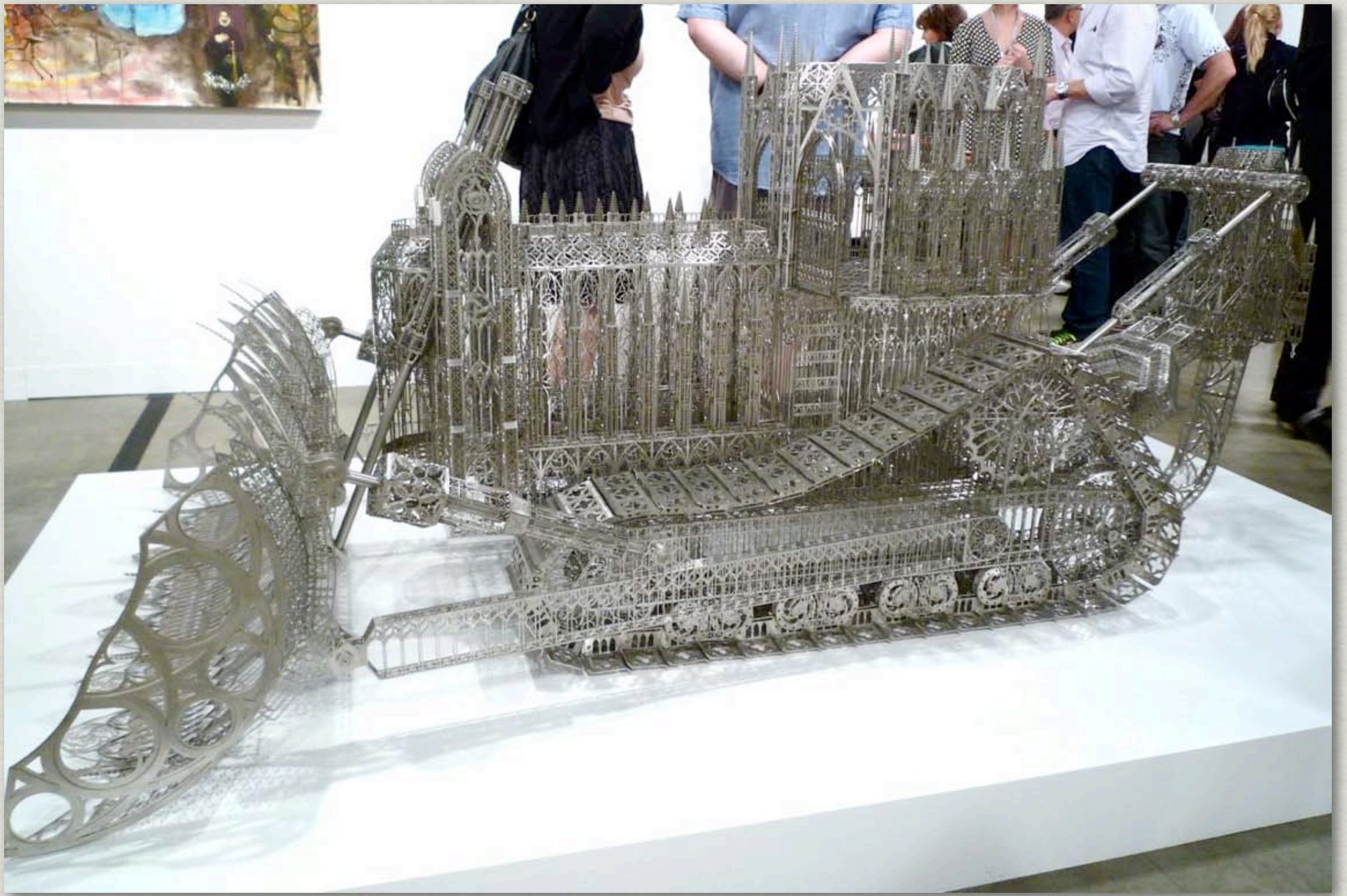
Objetos Marchitos (2008)
Dan Funderburgh

Tool Wall (2009)
Dan Funderburgh

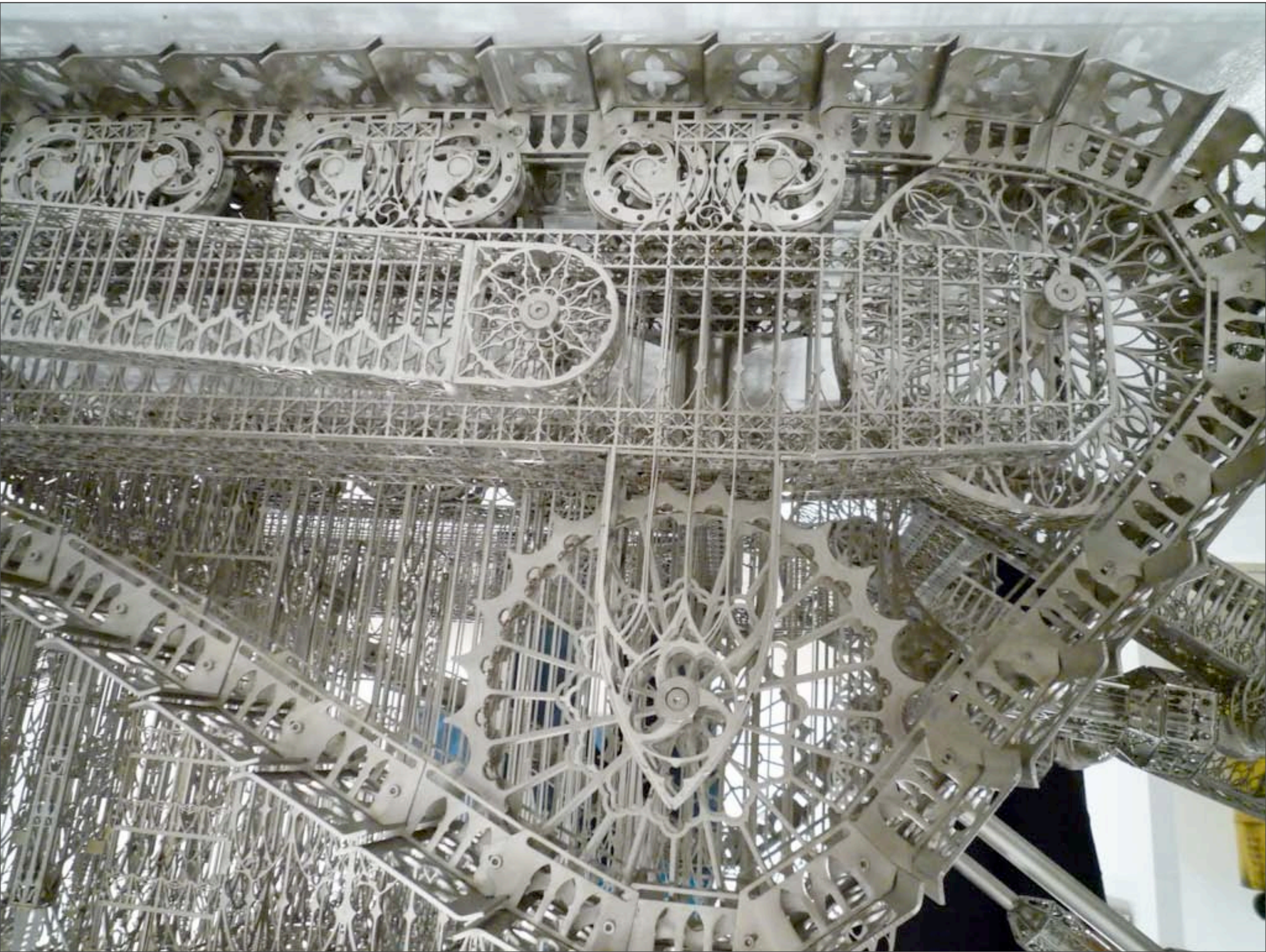


Uppercase scarf
Little Factory



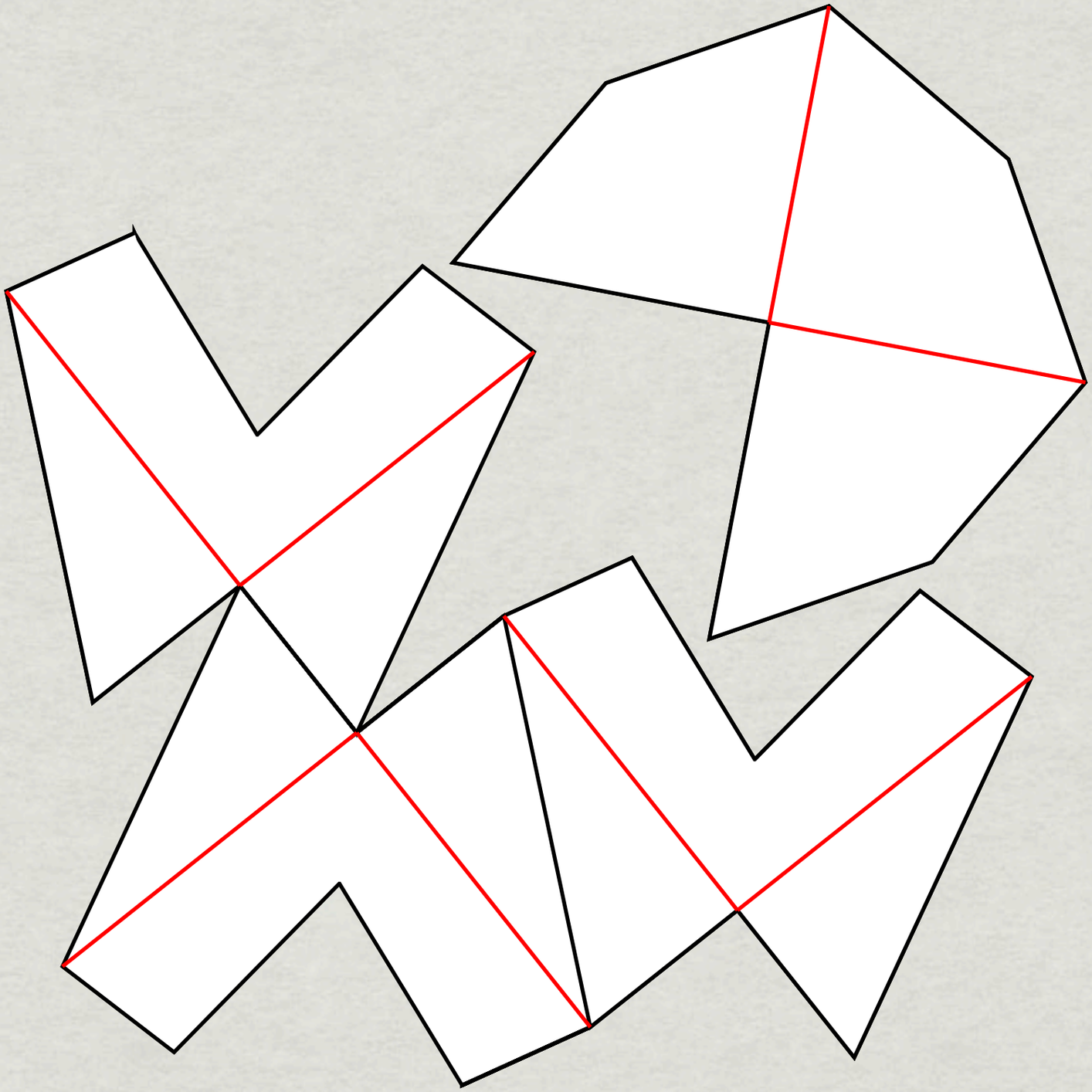


Wim Delvoye




REISEBÜ

Mathematical models



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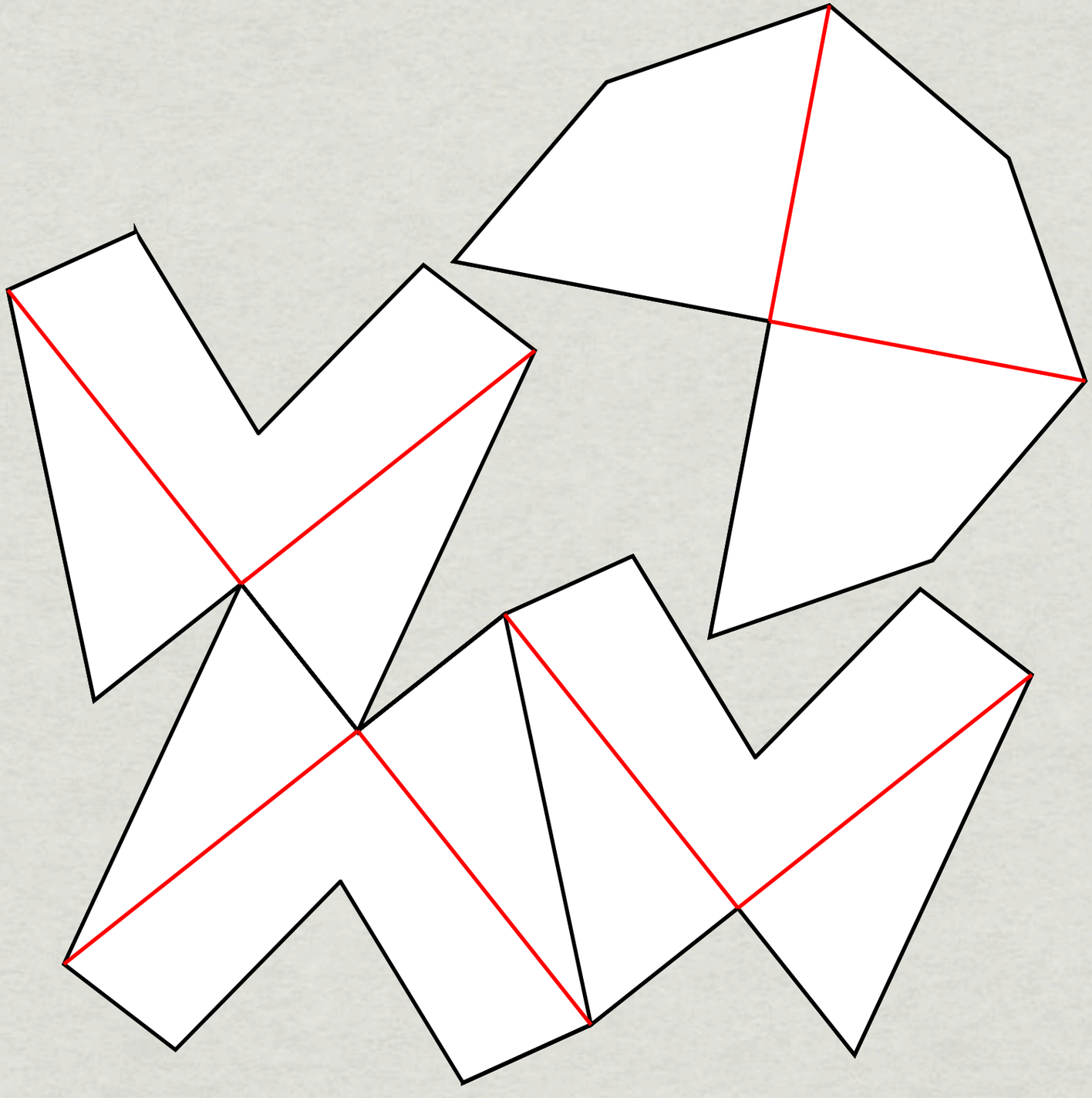
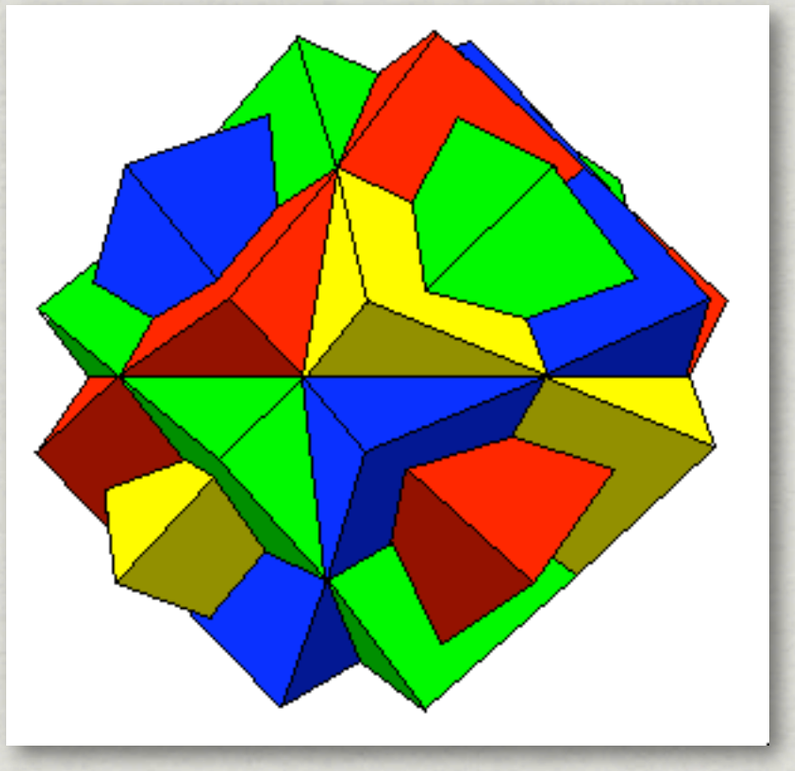
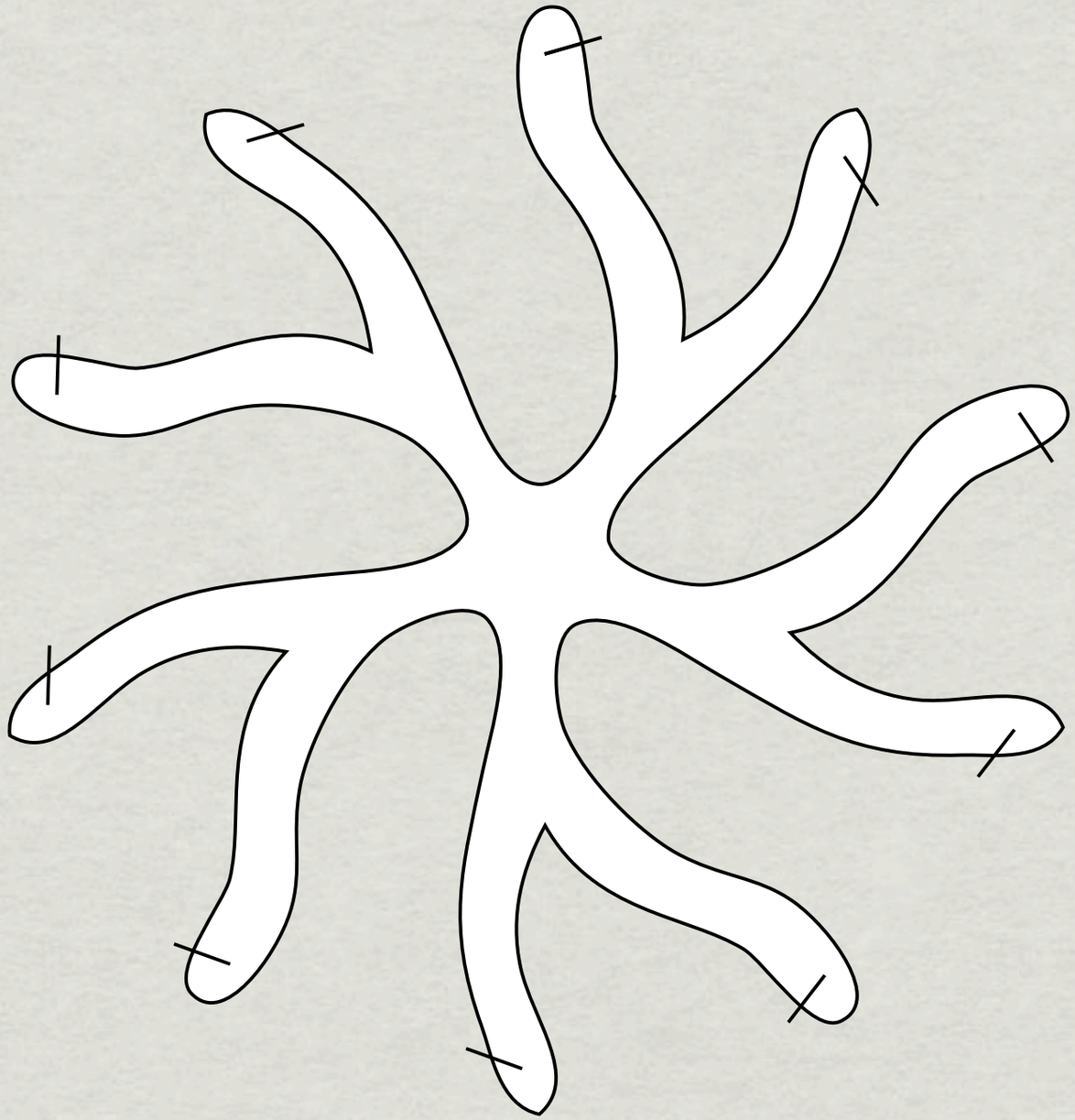




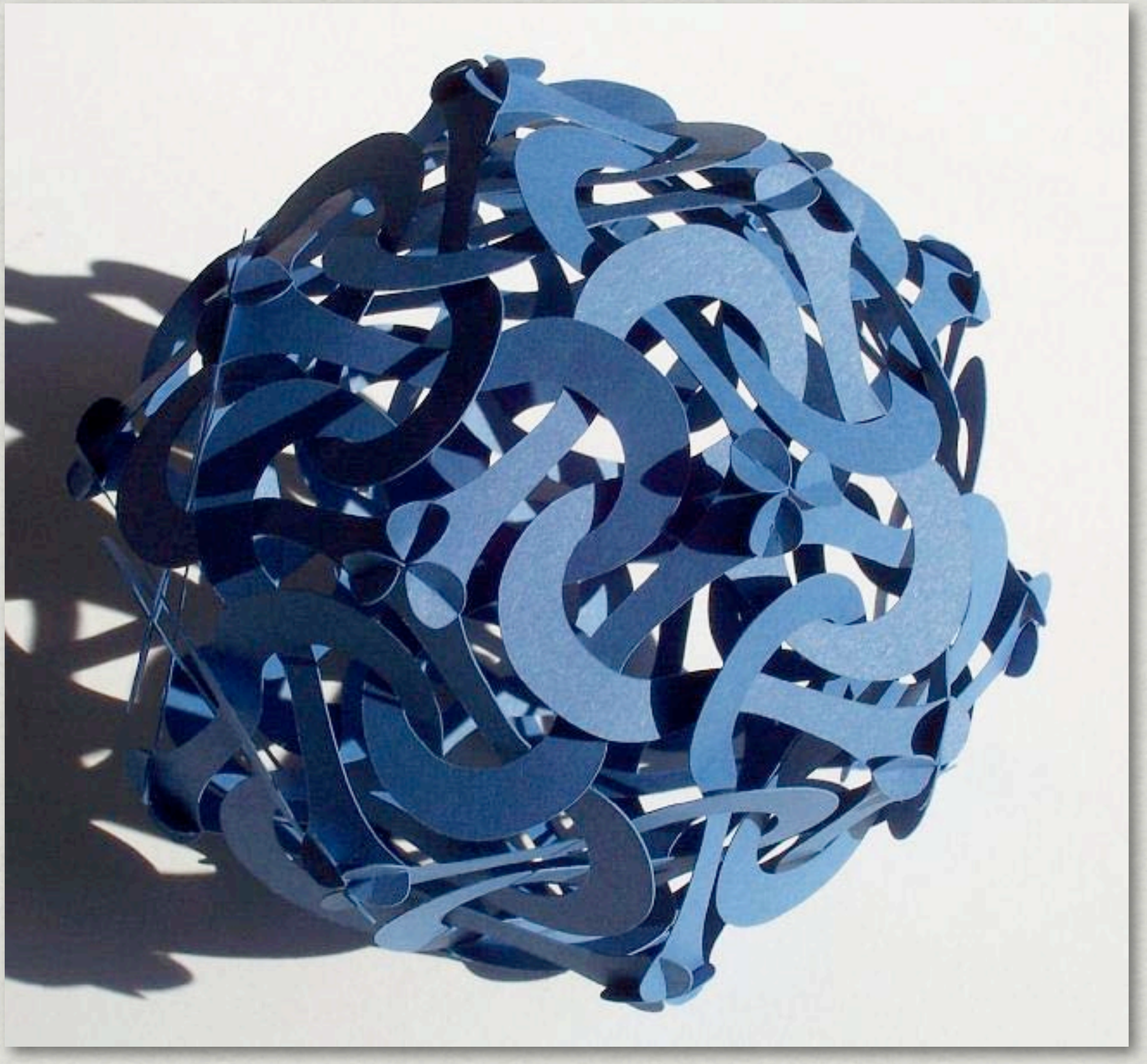
Shad Valley, 2007

Modular Kirigami

(George Hart, Bridges 2007)

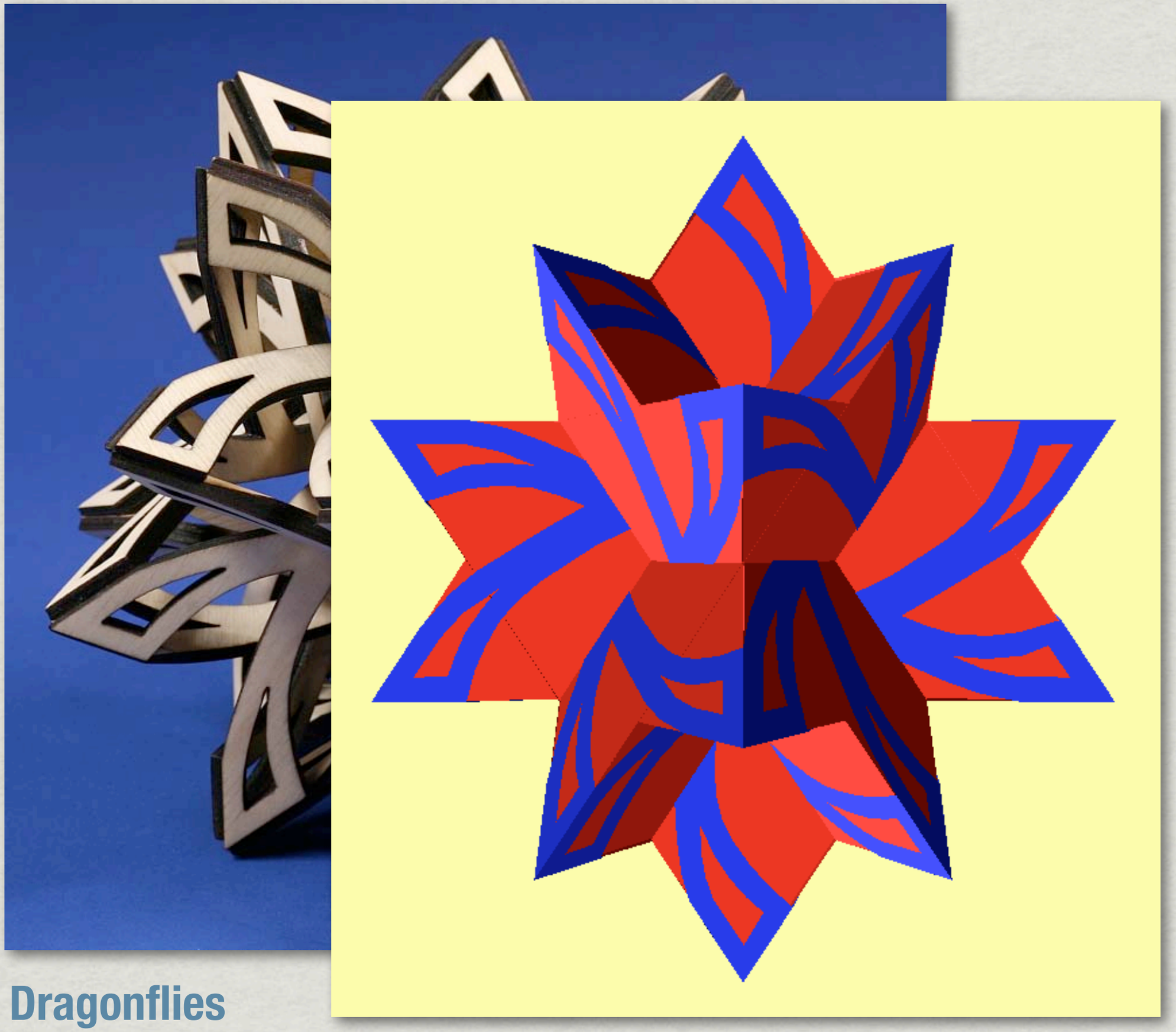


Deep Sea Tango

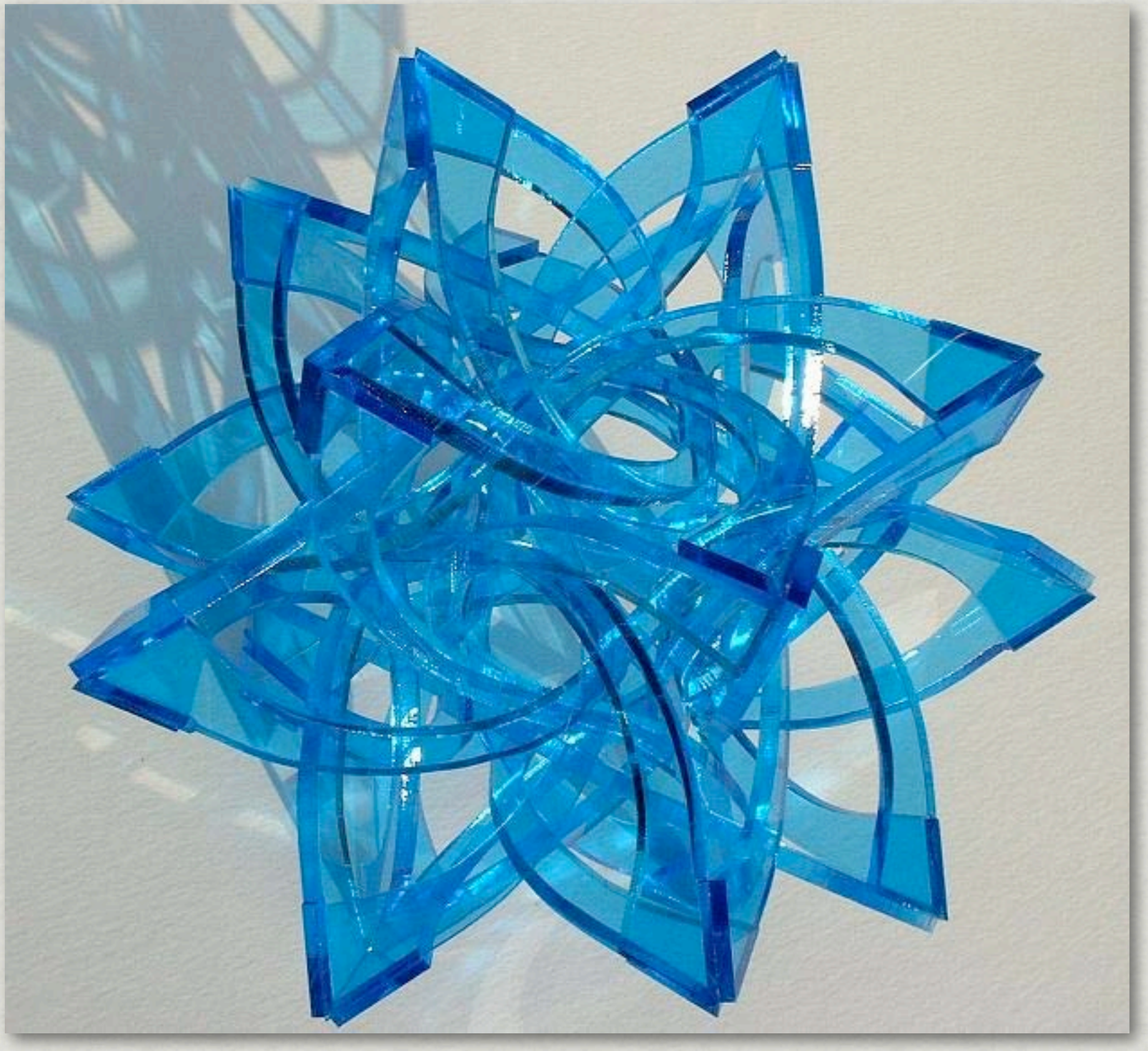


Meanders

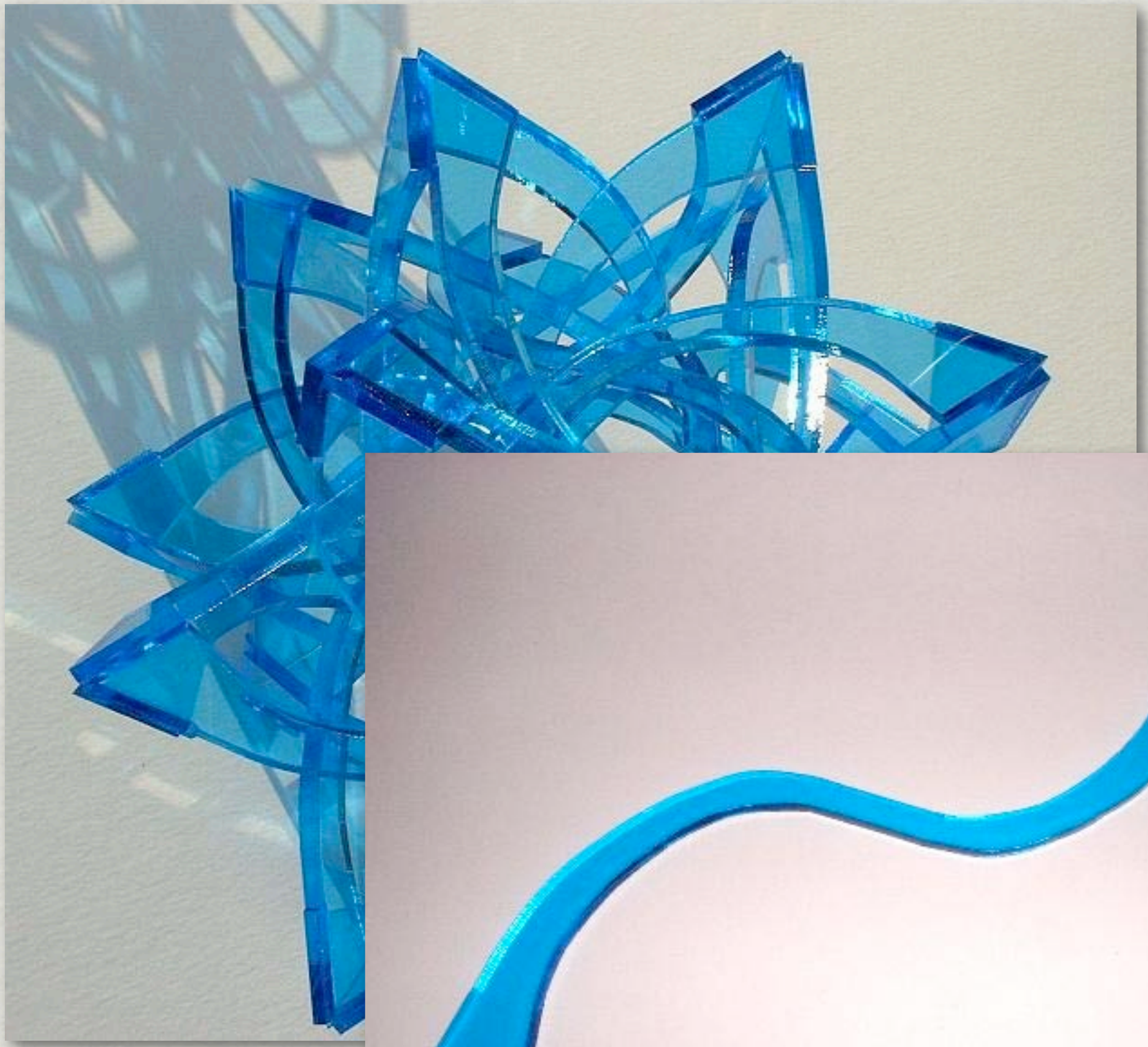
Dragonflies

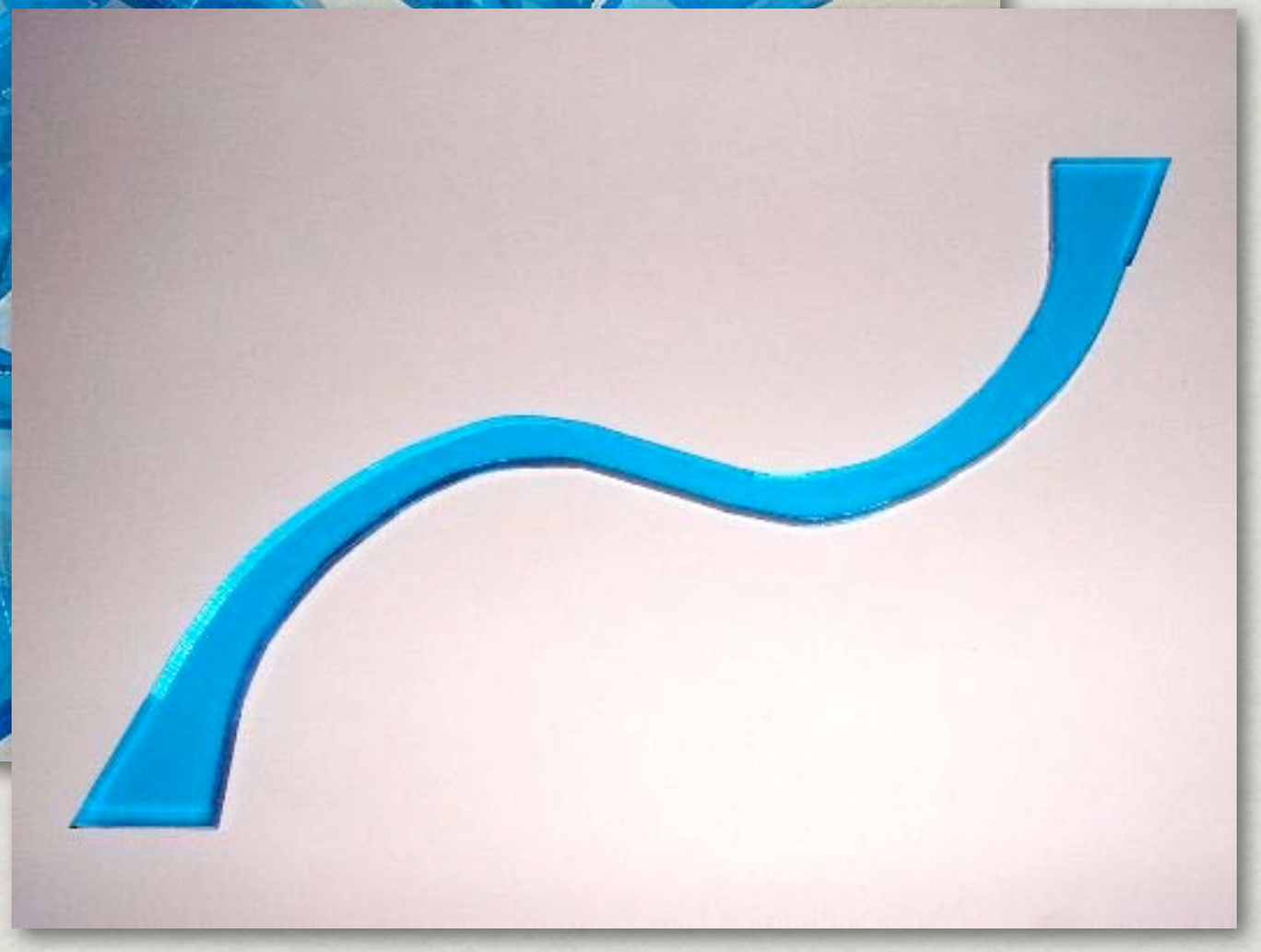


Dragonflies



Bouquet





Bouquet

2D: Do it yourself

- Build one
  - hacklab.to
- Use somebody else's
  - CSC, Architecture studio
- Pay someone to do it
  - lazerit.ca
- Use an online service
  - ponoko.com

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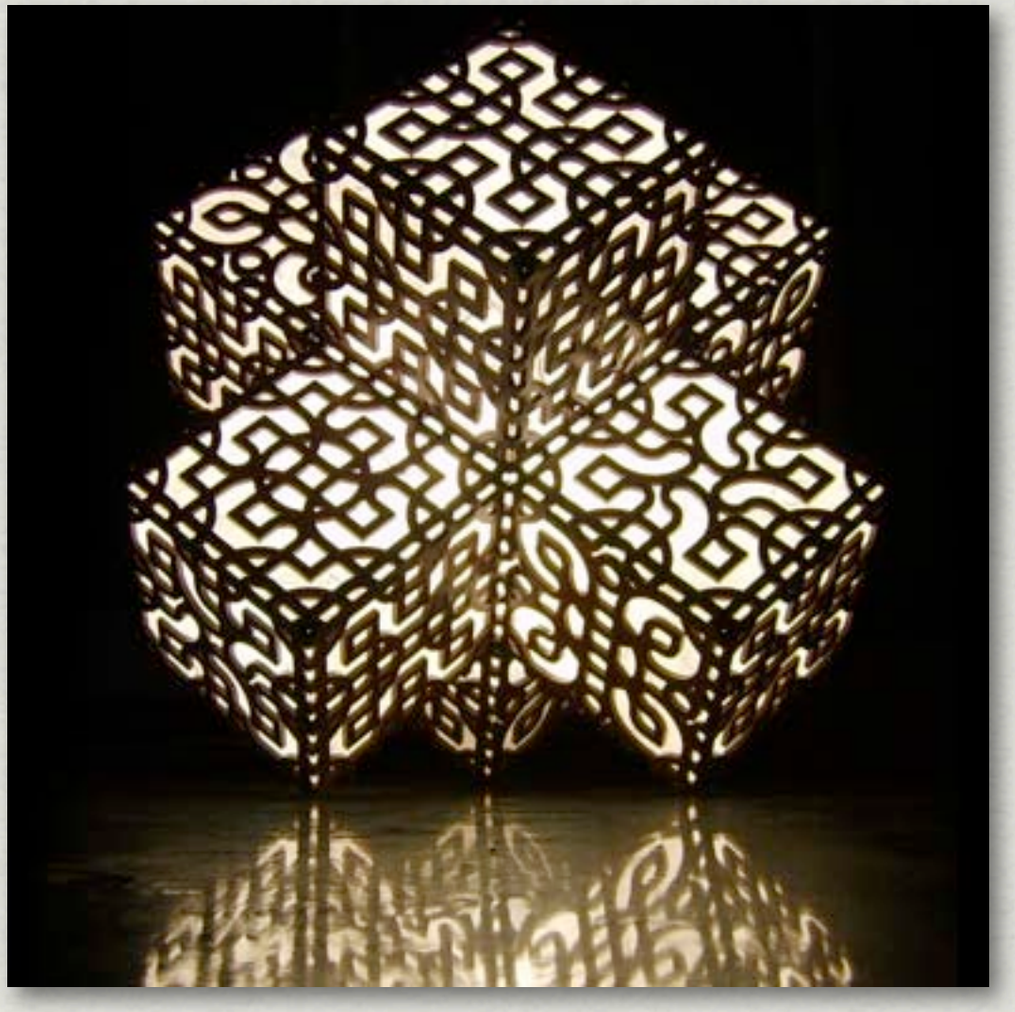
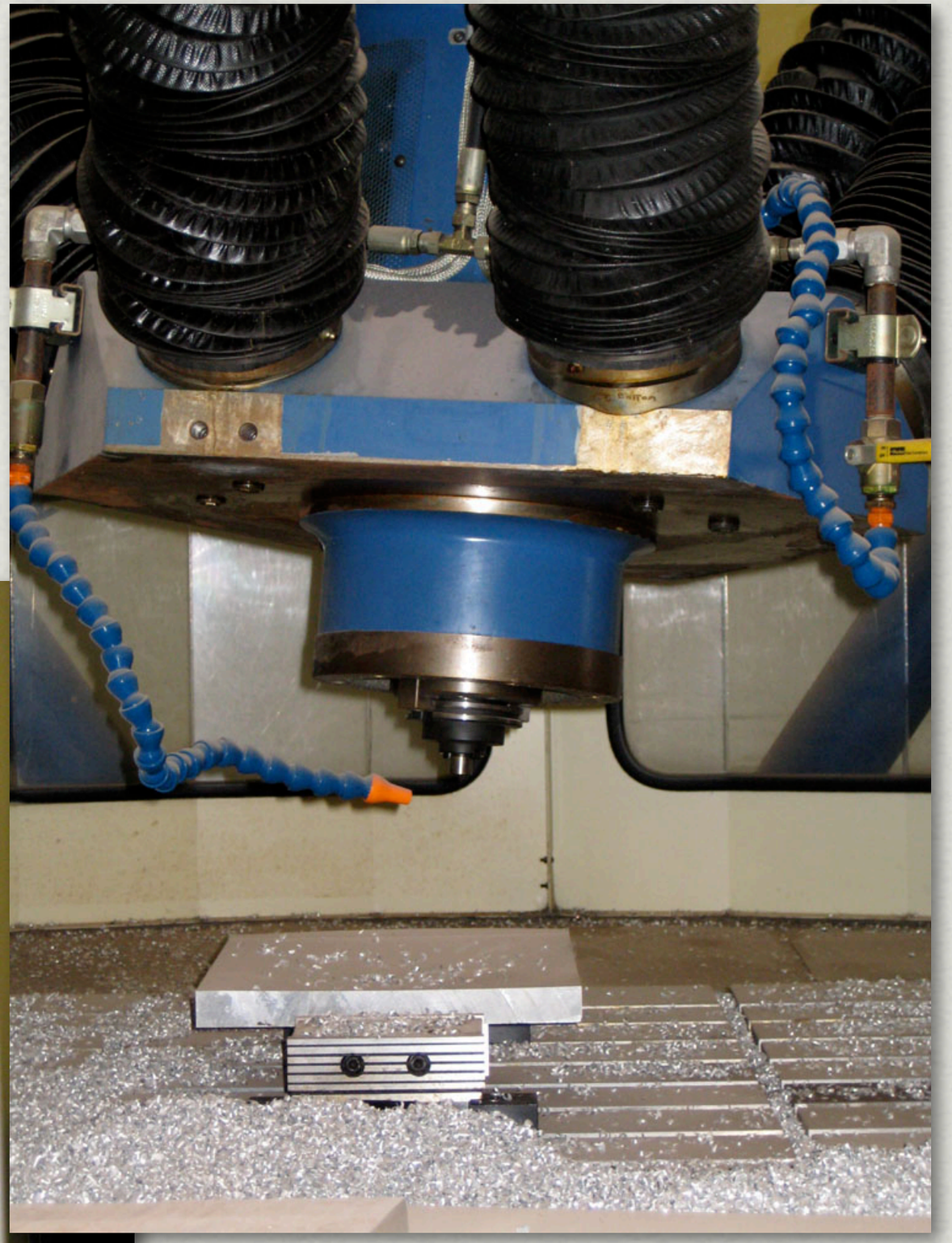
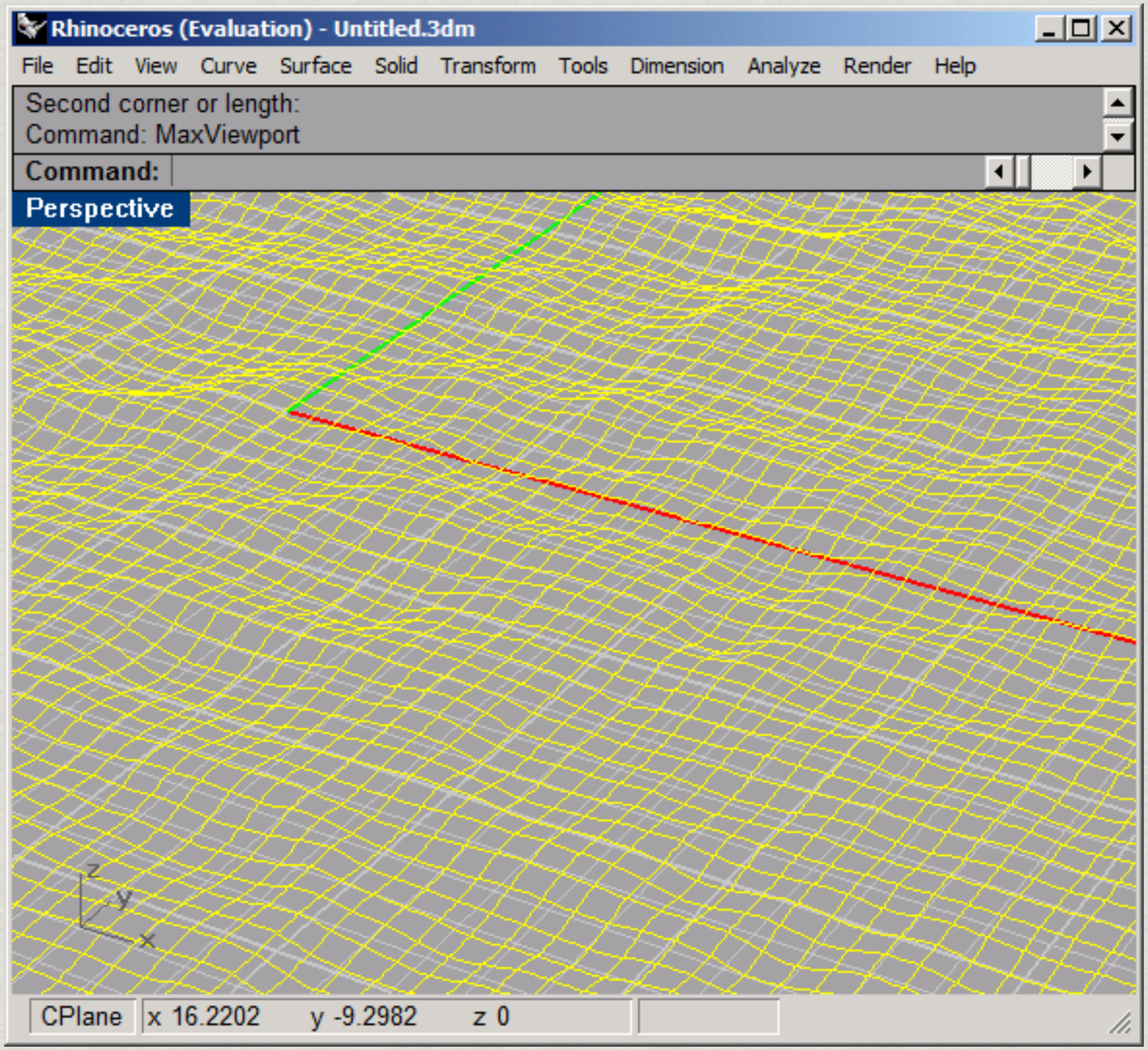


Intermezzo: CNC machining

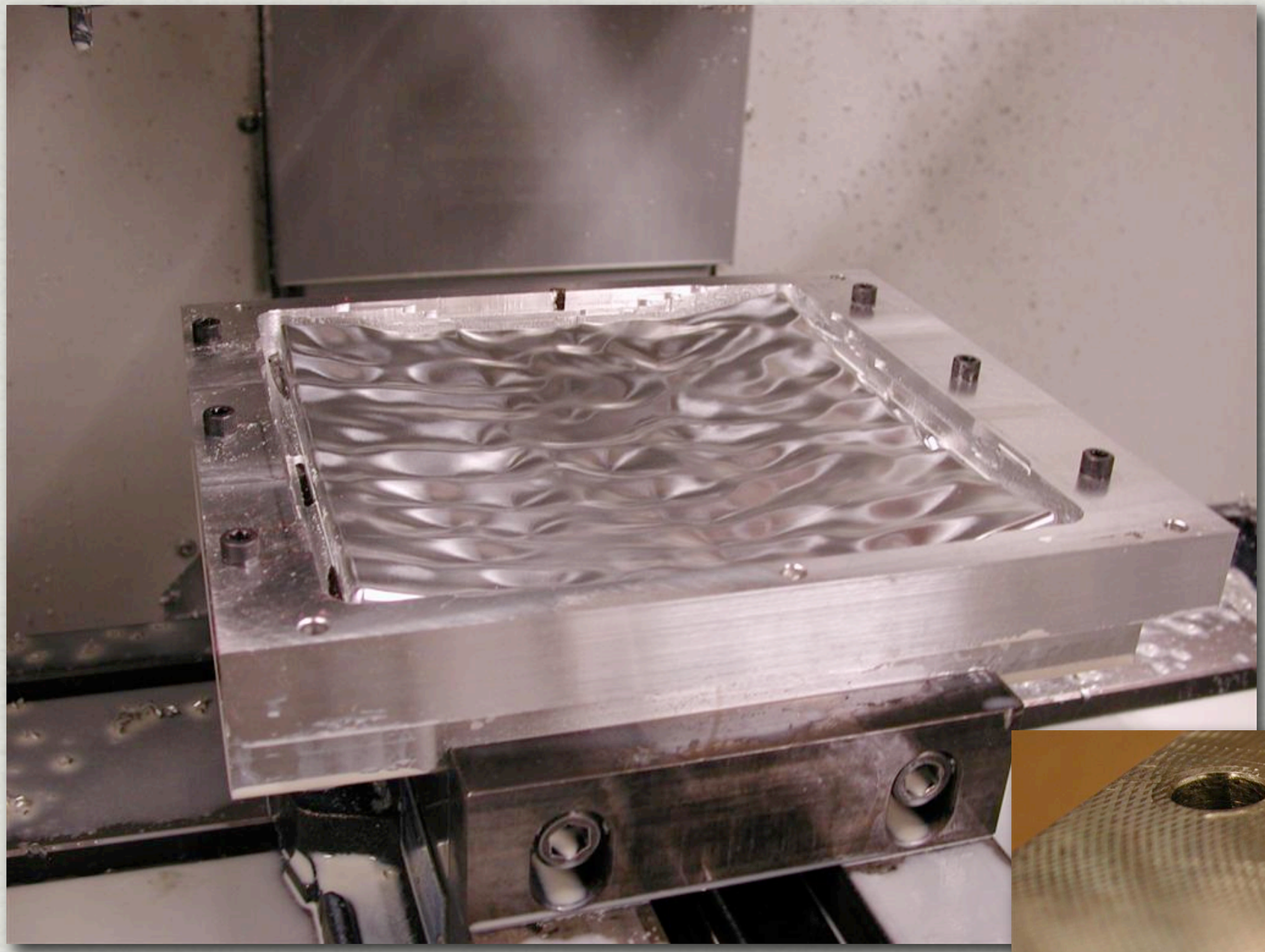
- Tool head drives high-speed bit
- Tool can move up and down (3-axis) and tilt (5-axis)
- Very wide range of scales

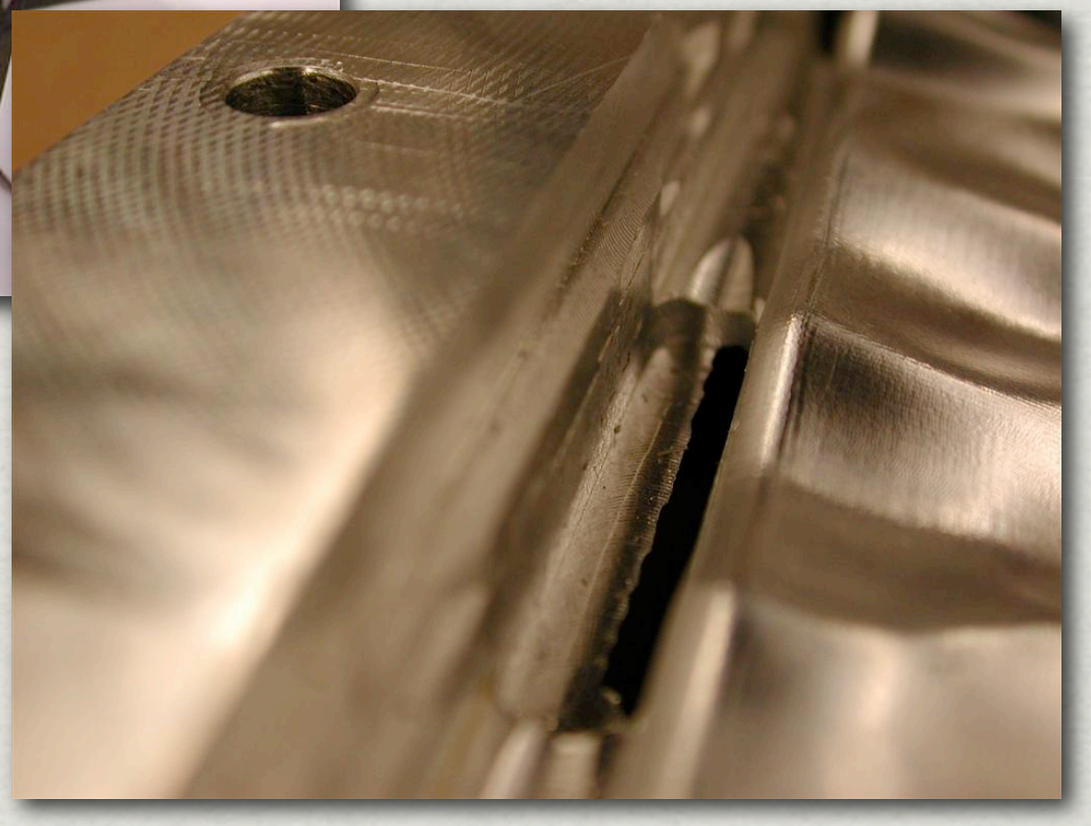

DMU 80 P hi-dyn
DECKEL MAHO

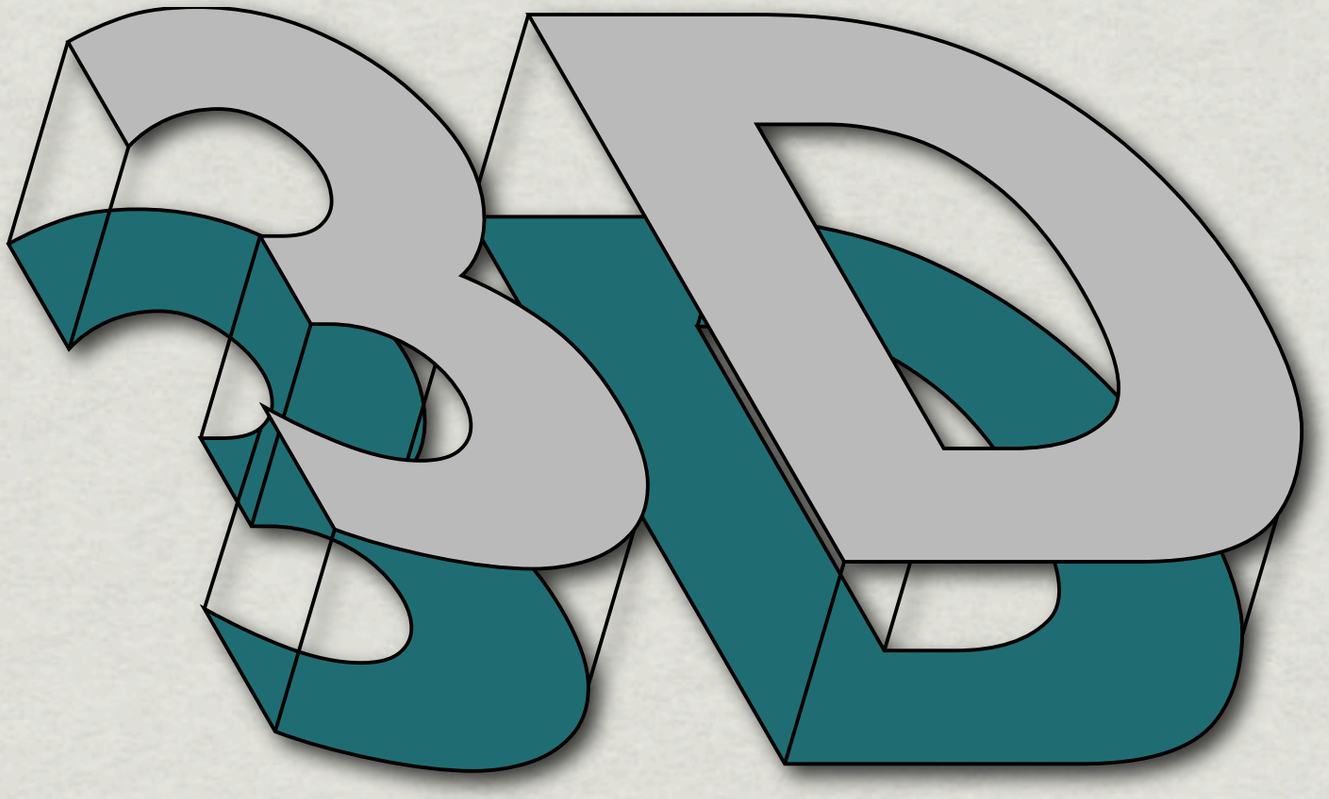




Sushi plate, Georg Petchnigg (2002)






3D

3D Technology

- Moving tool head ejects material or glues it together
- Parts built up layer by layer

Selective laser sintering

- Work bed contains stainless steel powder coated with binder
- Laser activates binder
- Work bed descends after each layer
- Baking, filling voids, finishing

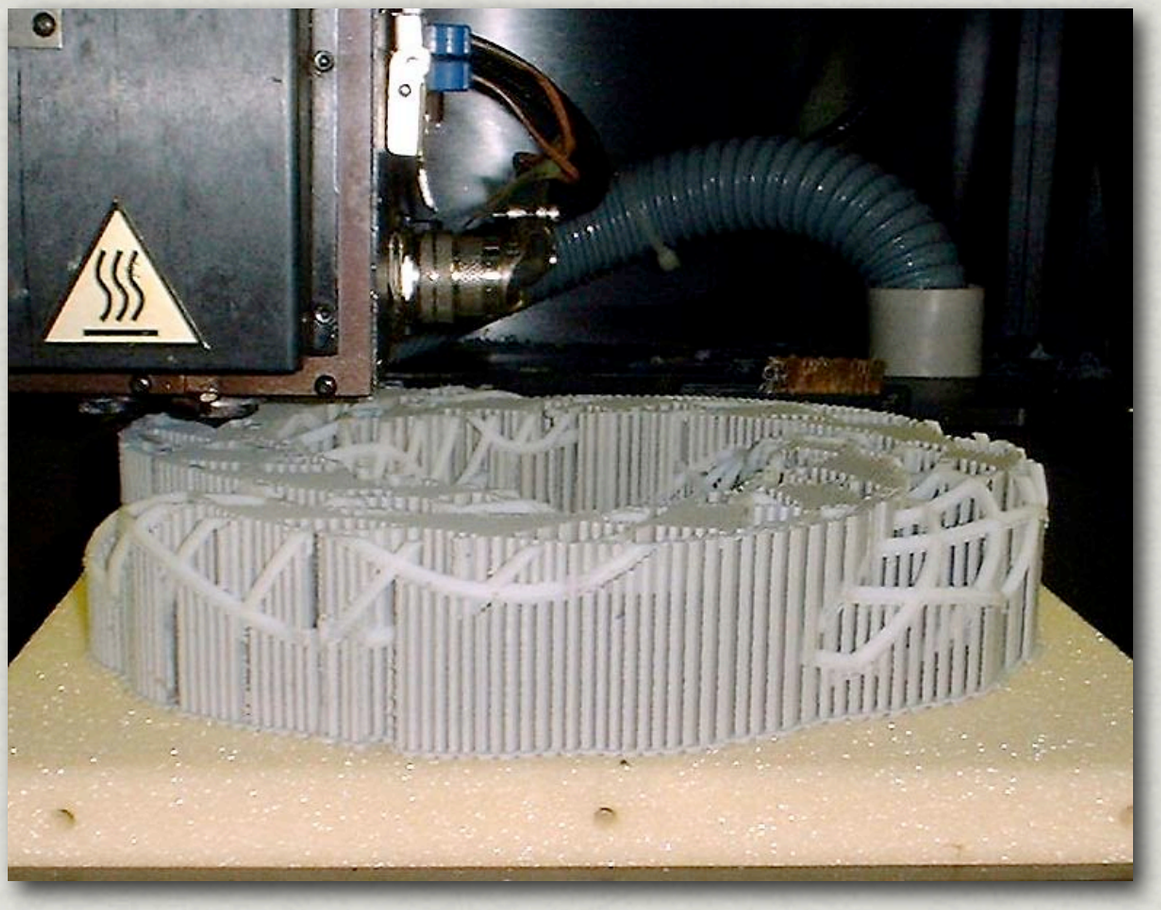
Other powders

Z-Corp: cornstarch and glue

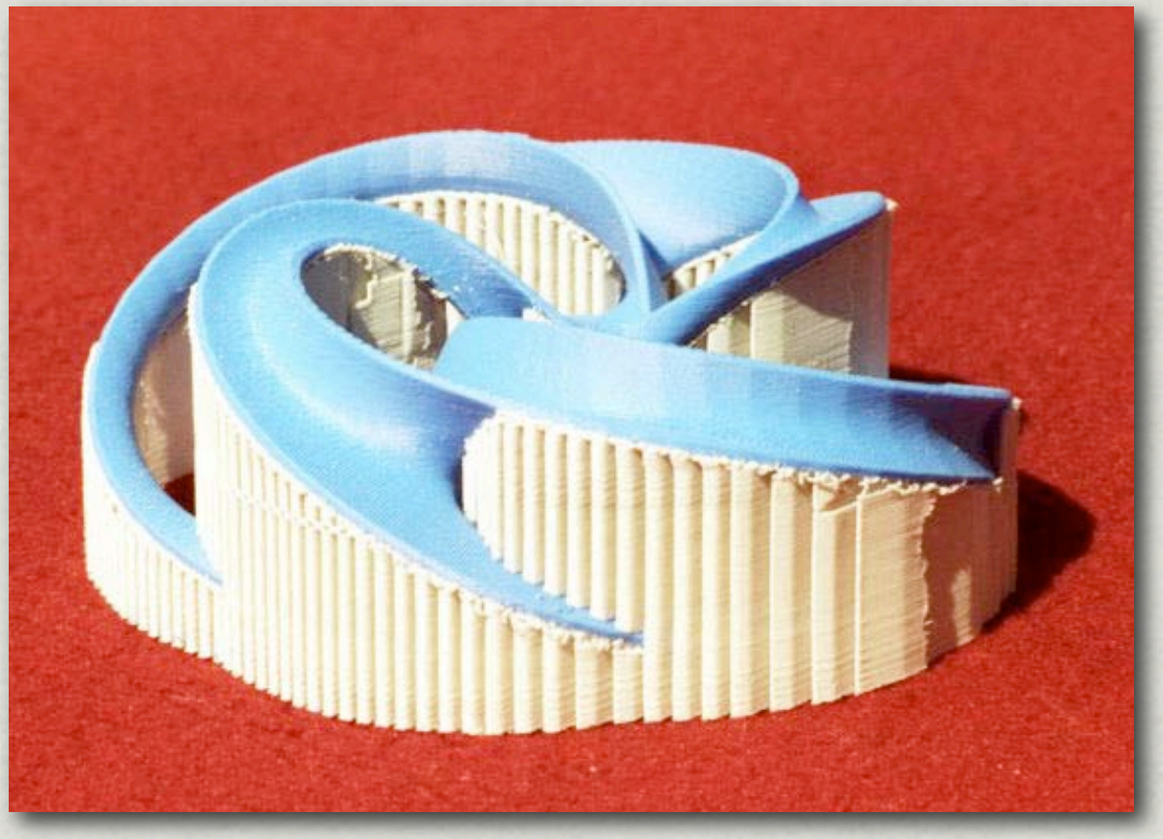
CandyFab: sugar and hot air

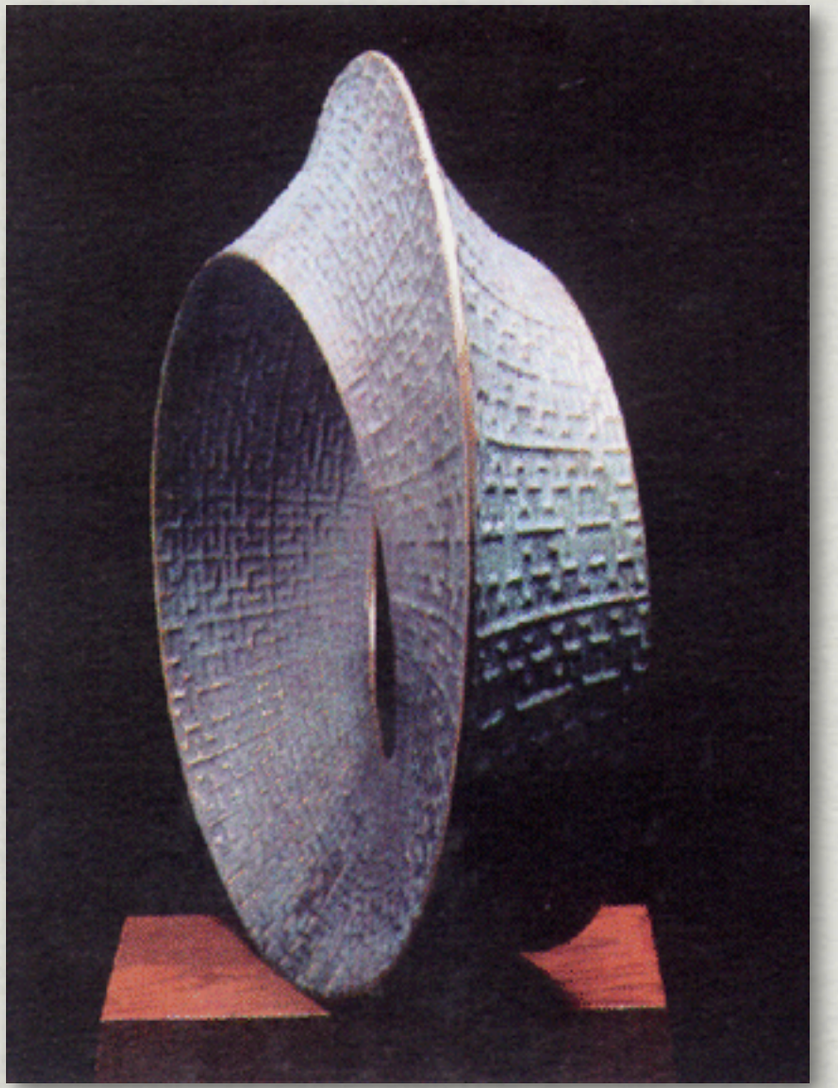
Fused Deposition Modelling

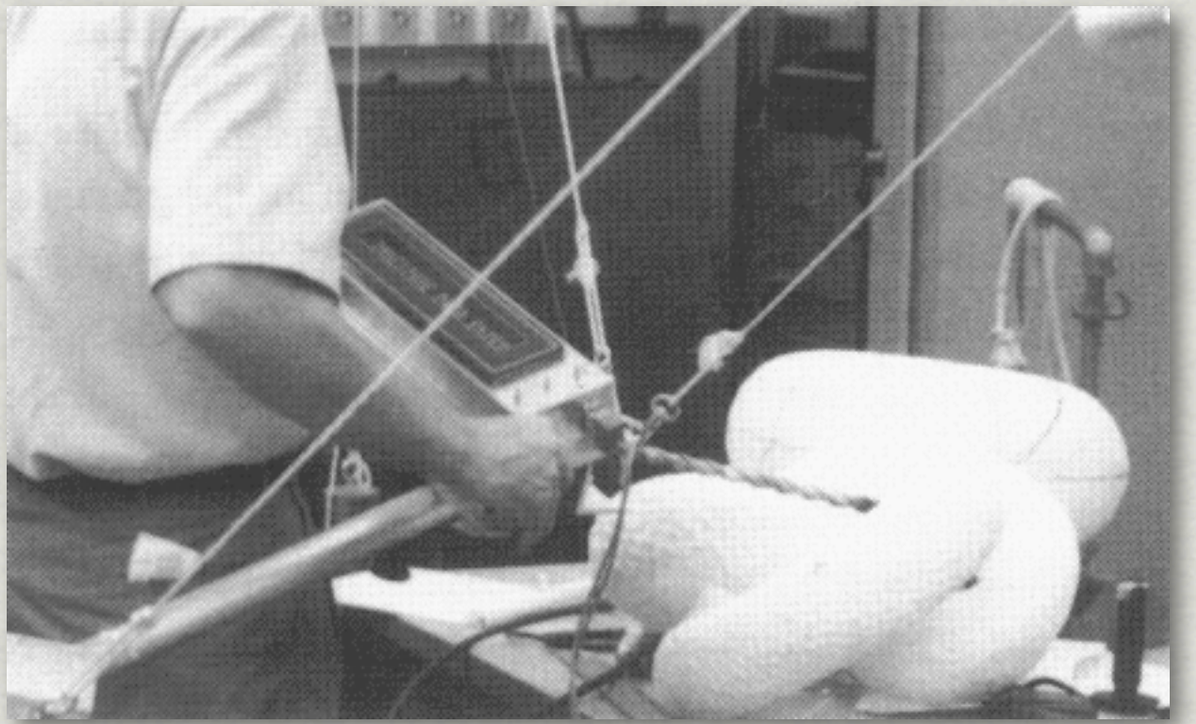
- Nozzle extrudes molten ABS plastic filament layer by layer
- Not freestanding: need secondary support material



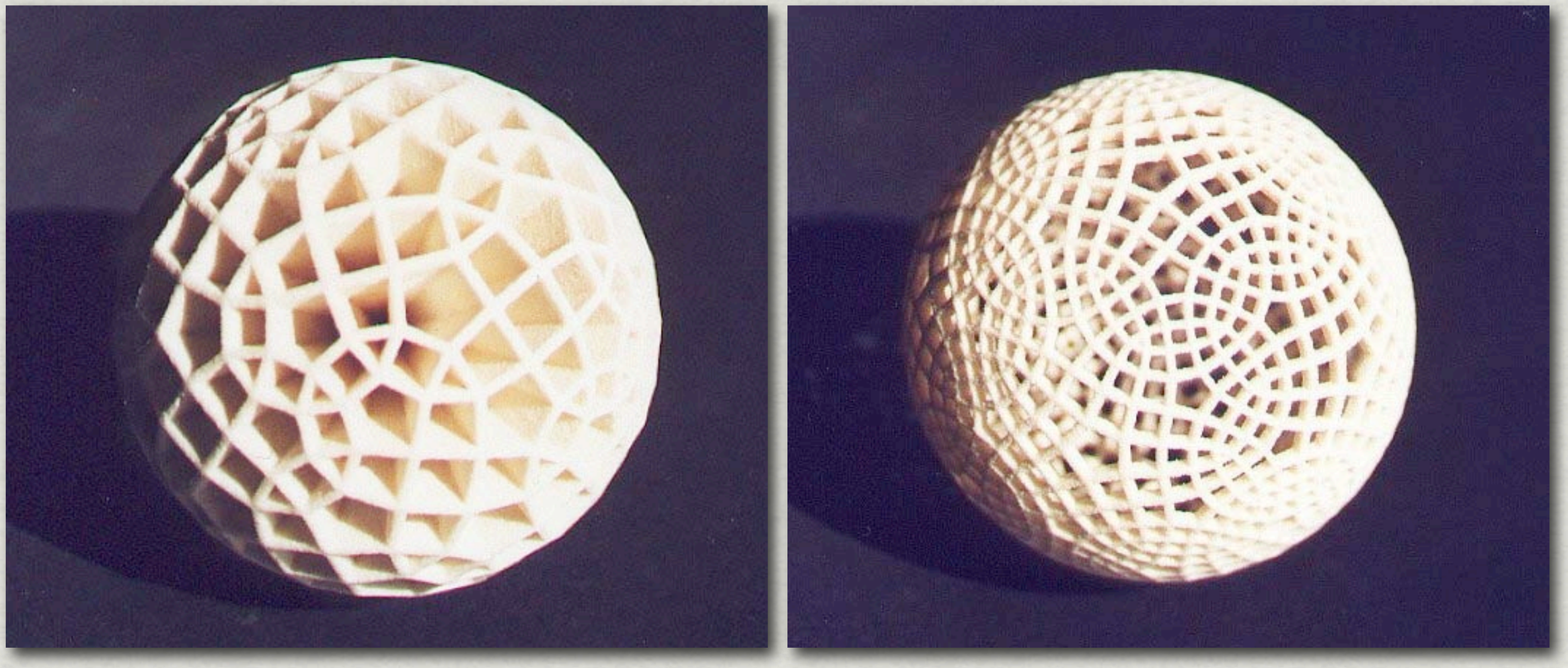
FDM Support material



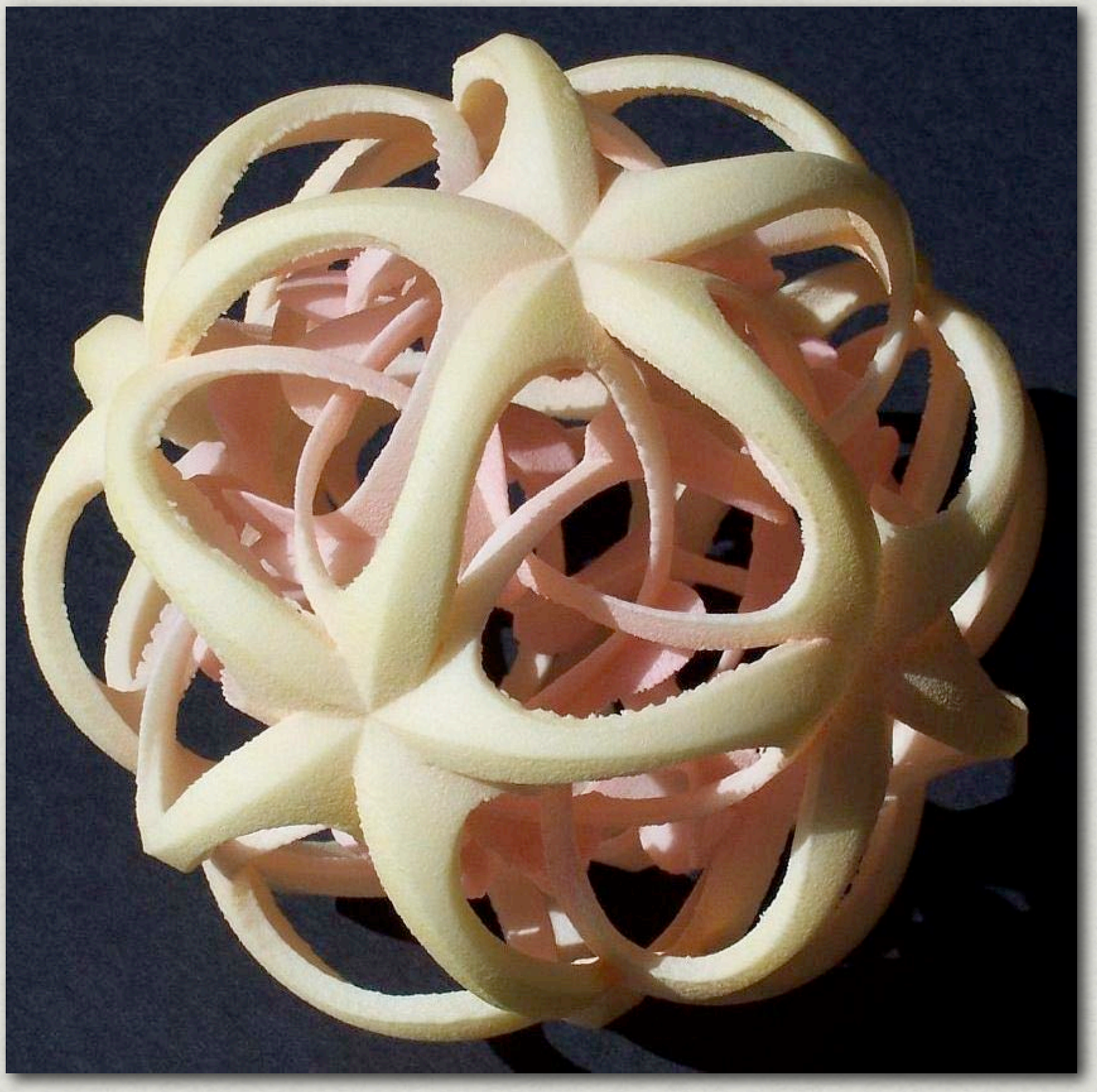




Umbilic Torus NC, Helaman Ferguson



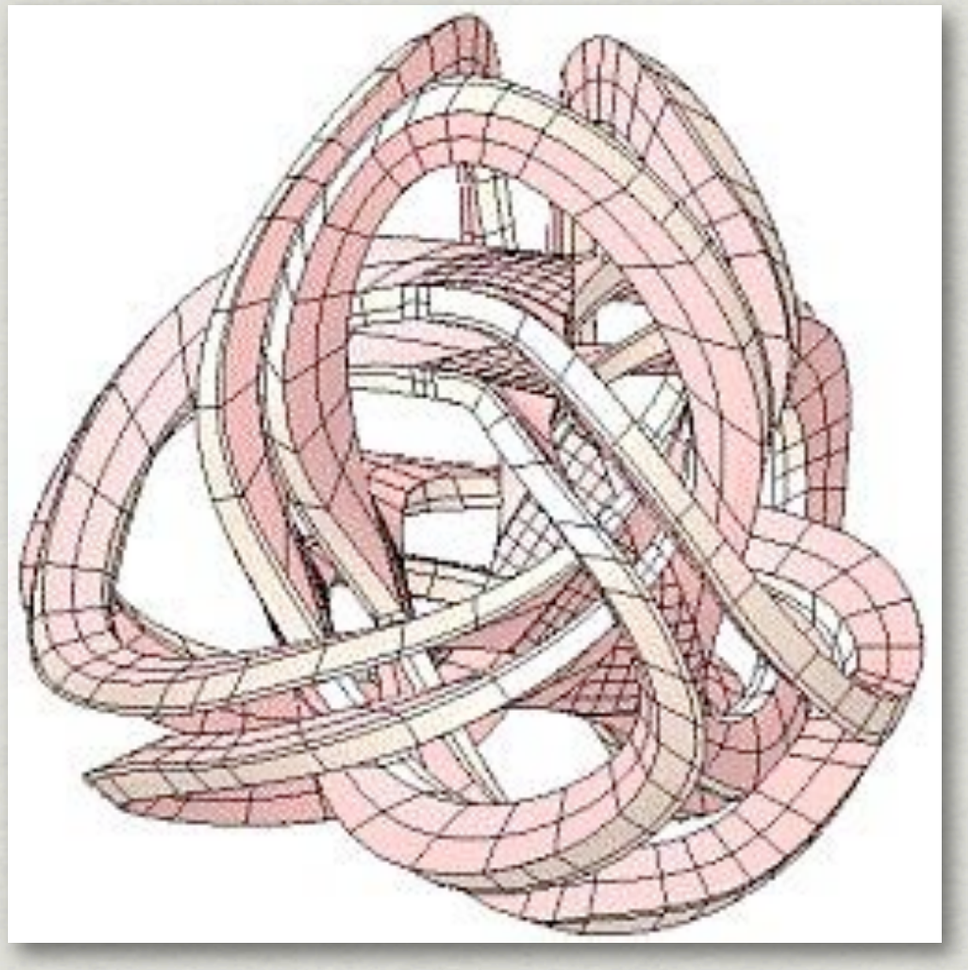
Gonads of the Rich and Famous, George Hart (~2000)



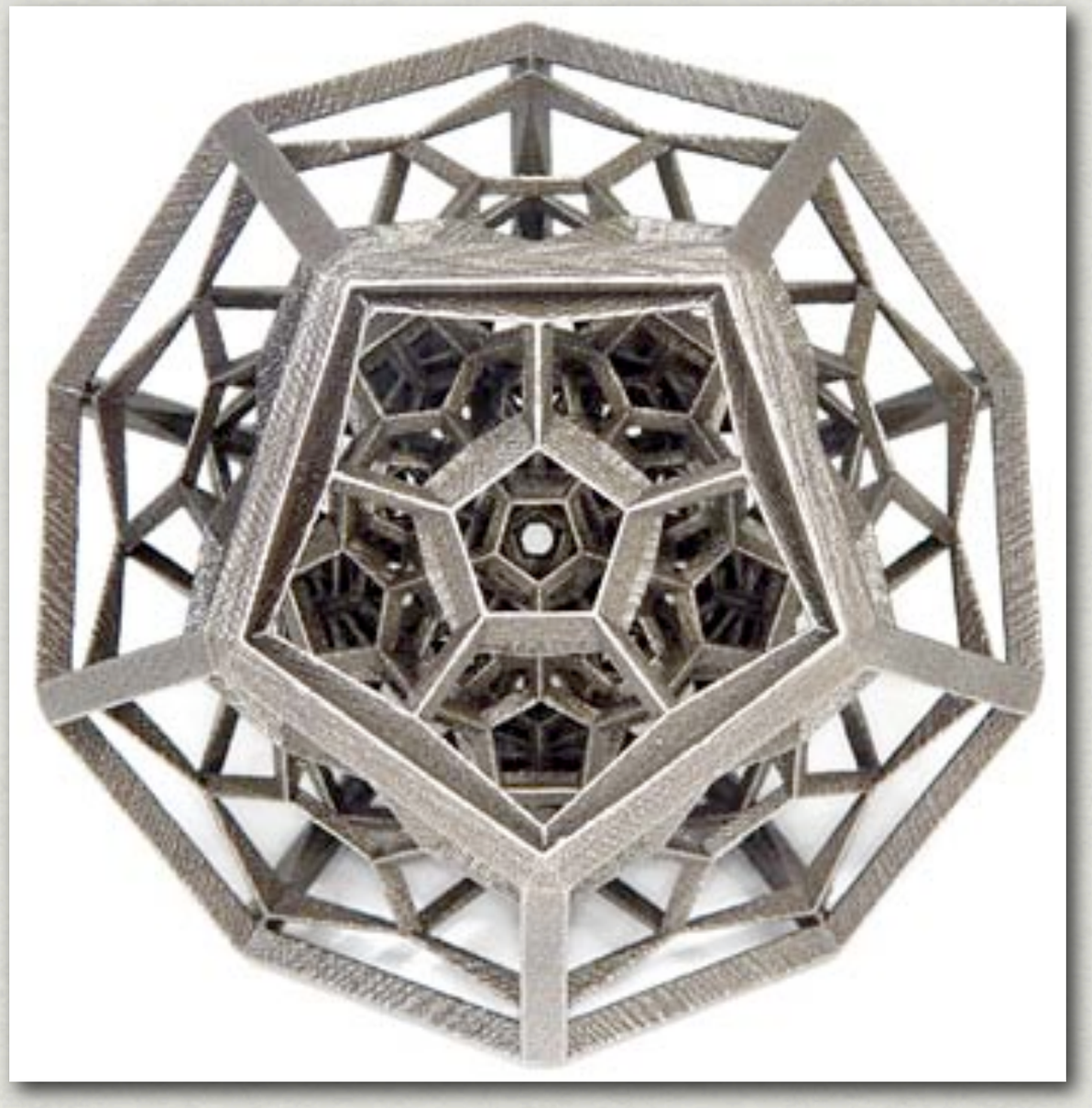
Mermaid's Delight, George Hart (2006)

Echinodermania, George Hart (2007)

Quintrino & Quintron, Bathsheba Grossman

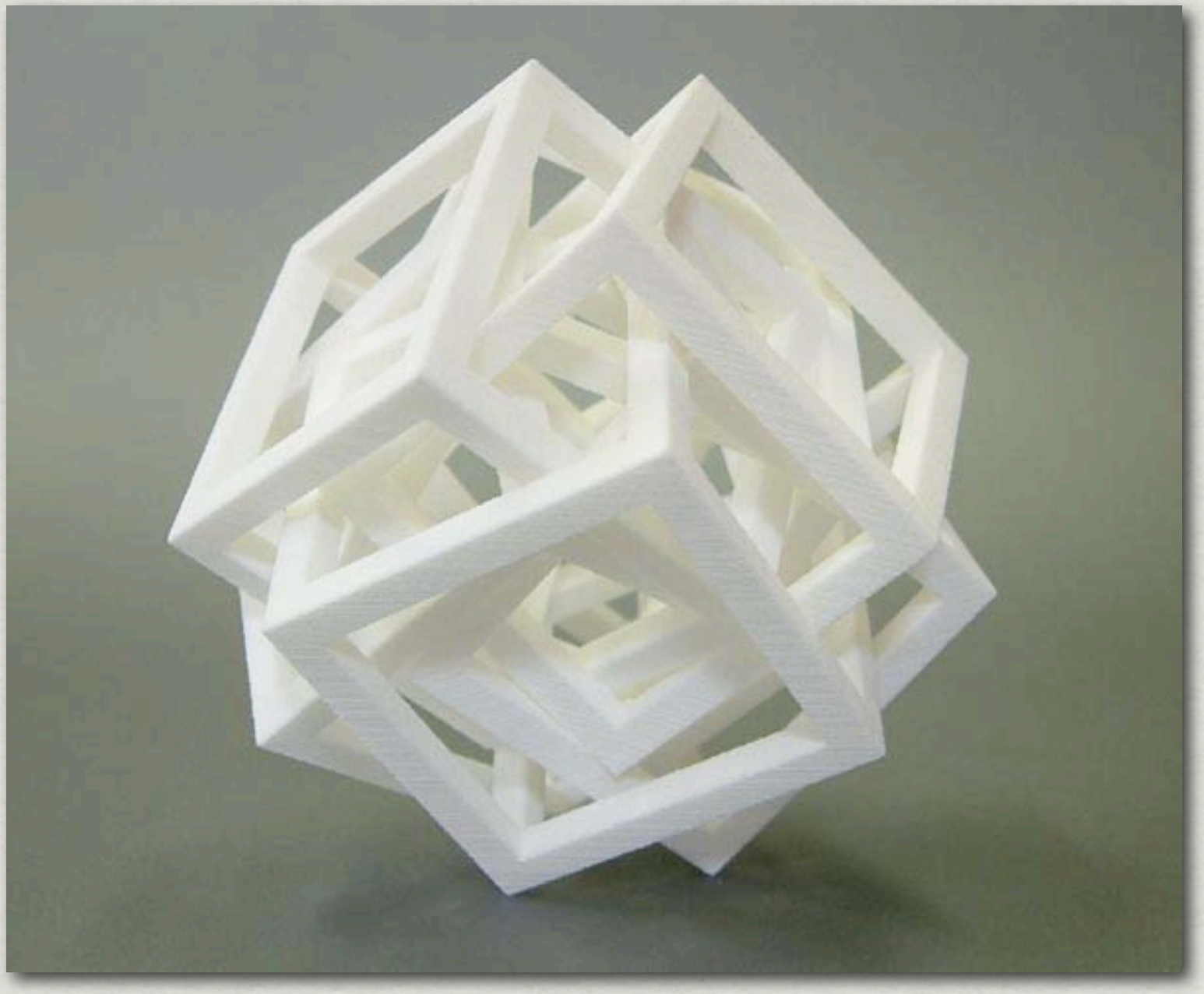


Metatron, Bathsheba Grossman



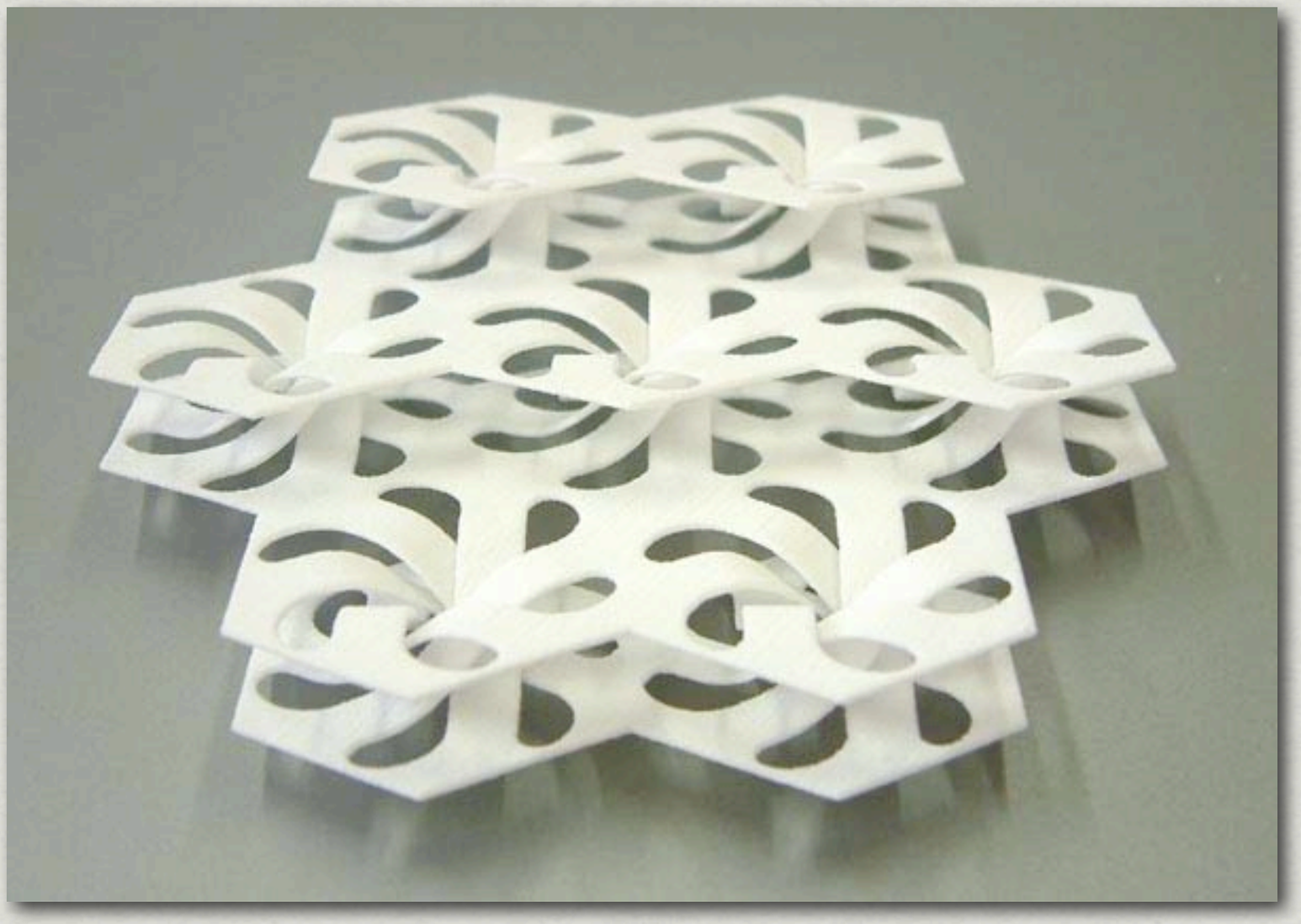
120-Cell, Bathsheba Grossman

Origami I and Rhombic Triacontahedron IV, Vladimir Bulatov



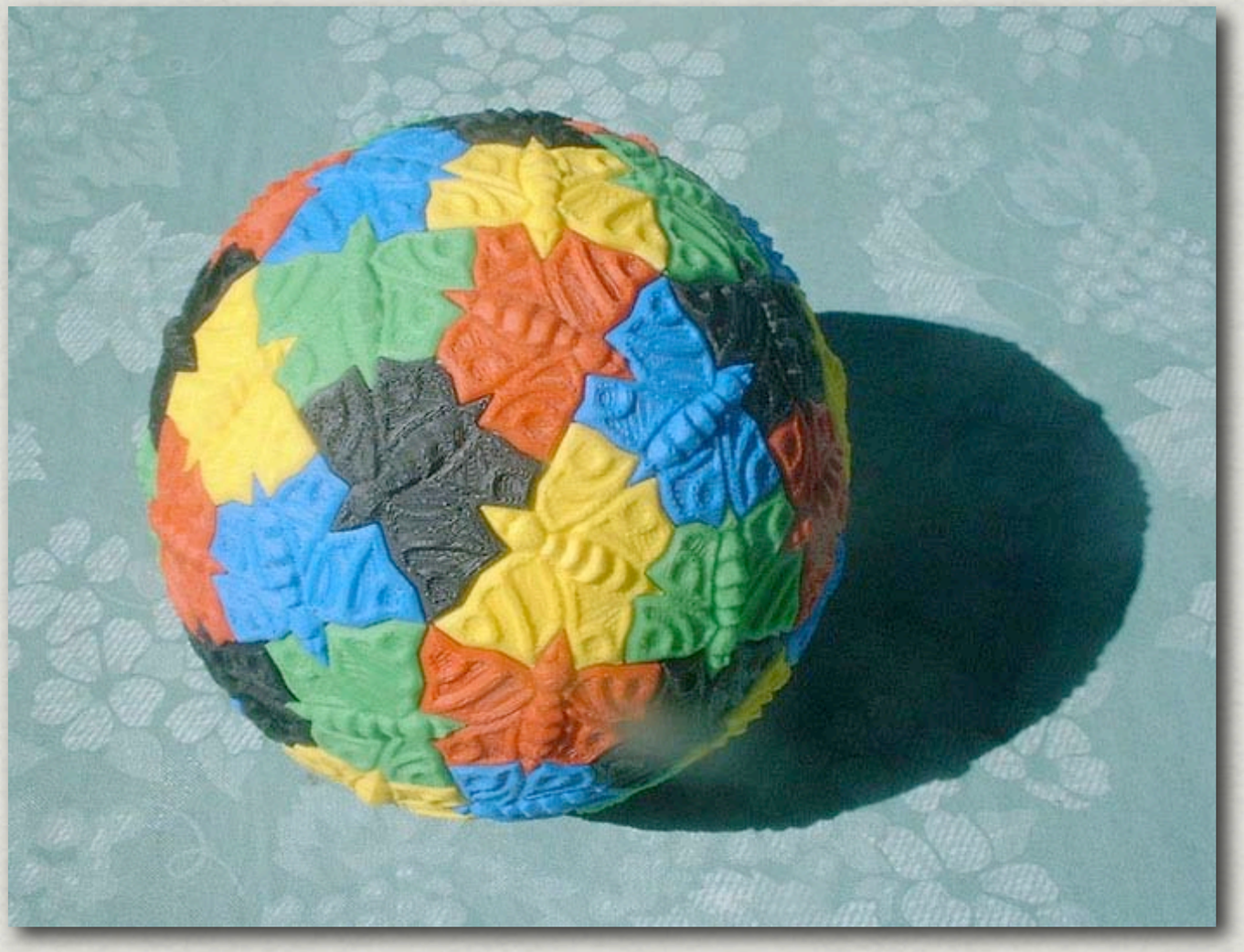
6 Cubes, Rinus Roelofs

7 Linked Cubes, Rinus Roelofs



Multilayer Hexagonal Structure, Rinus Roelofs

Ergun Akleman



60 Butterflies, Carlo Séquin (2001)

Chinese Button Knot, Carlo Séquin (2007)

Whirled White Web, Carlo Séquin (2003)

2003 Breckenridge snow sculpting competition


RIV
R POST

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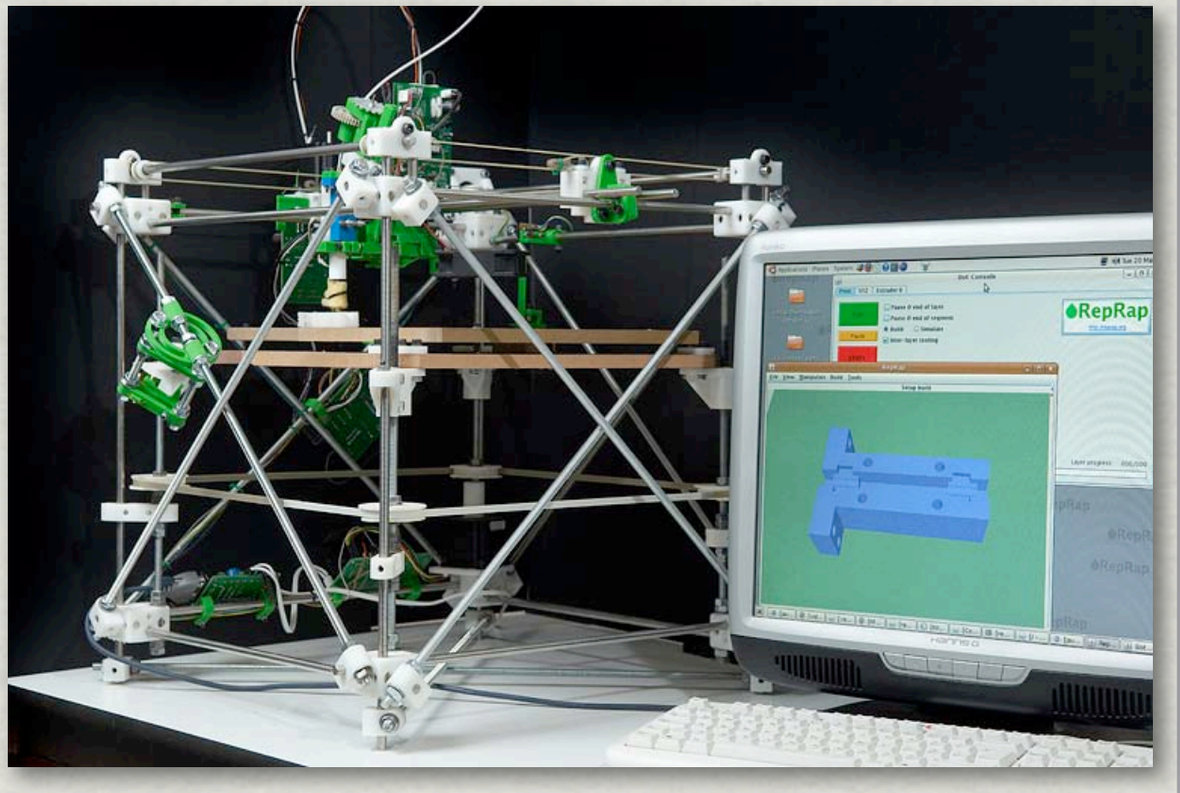

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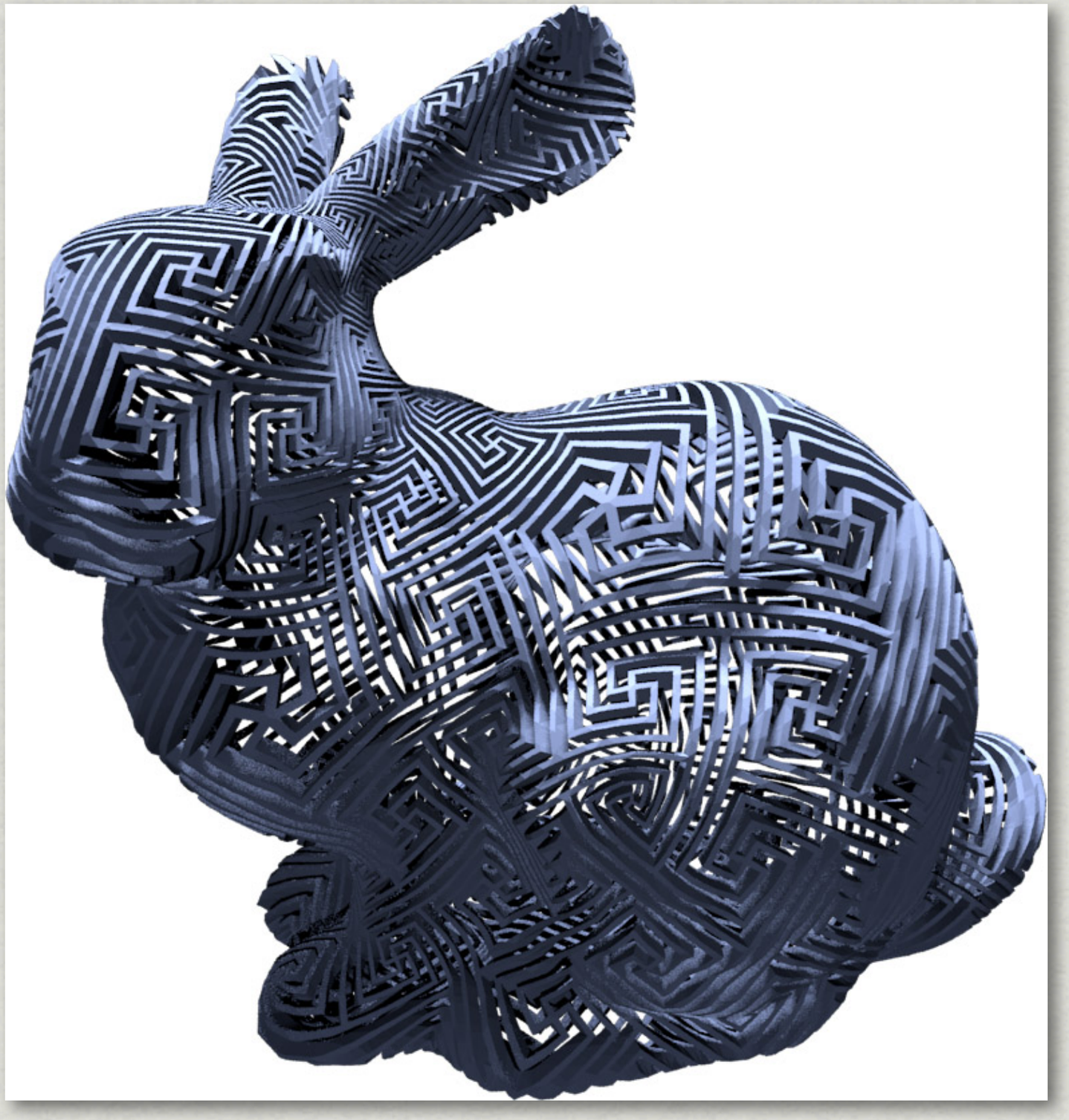

Conclusion

- These tools represent a potential revolution in art and design
  - Artists gain more power and flexibility
  - Art is the design of a *process*, not an artifact
  - Non-artists can express themselves

Thank you!